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A HISTORY OF WARTIME RESEARCH AND DEVELOPMENT  
OF  
MEDICAL FIELD EQUIPMENT

by

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(This is not the final form in which the subject of research and development of medical field equipment will be covered in THE HISTORY OF THE MEDICAL DEPARTMENT DURING WORLD WAR II. This monograph has not been reviewed by the Historical Division, War Department Special Staff.)

WAR DEPARTMENT

OFFICE OF THE SURGEON GENERAL

30 June 1946

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UNITED STATES GOVERNMENT

OFFICE OF THE SECRETARY OF THE ARMY

STANDARD FORM NO. 64

TO: *Mr. [illegible]*

FROM: *Mr. [illegible]*

SUBJECT: *[illegible]*

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UH  
440  
9U5825hi  
1946  
pt.2

THIS IS NOT A RECOMMENDATION

THESE ARE THE FACTS OF THE CASE AS REPORTED BY THE OFFICIALS OF THE ARMY AND NAVY WHO HAVE BEEN INVESTIGATING THE MATTER SINCE THE REPORT WAS MADE TO THE SECRETARY OF THE ARMY.

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THE SECRETARY OF THE ARMY HAS REVIEWED THE MATTER AND HAS DETERMINED THAT THE MATTER IS NOT A RECOMMENDATION.

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LIST OF ABBREVIATIONS USED IN FOOTNOTES

A. G. ( <u>or</u> T. A. G.)	The Adjutant General
A. G. F.	Army Ground Forces
A. G. O.	Office of The Adjutant General
A. M. C.	Army Medical Center
A. M. P. O.	Army Medical Purchasing Office
A. M. R. & D. Bd.	Army Medical Research and Development Board
A. S. F.	Army Service Forces
CBI	China-Burma-India Theater of Operations, United States Army
C. G. ( <u>or</u> T. C. G.)	The Commanding General
ETO ( <u>or</u> ETOUSA)	European Theater of Operations, United States Army
FM	Field Manual
M. D. E. L.	Medical Department Equipment Laboratory
M. D. T. C.	Medical Department Technical Committee
M. F. S. S.	Medical Field Service School
NATOUA	North African Theater of Operations, United States Army
O. Q. M. G.	Office of The Quartermaster General

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POA	Pacific Ocean Area
P. O. E.	Port of Embarkation
S. G. ( <u>or</u> T. S. G.)	The Surgeon General
S. G. O.	Office of The Surgeon General
S. O. S.	Services of Supply
SWPA	Southwest Pacific Area
T/O & E	Table of Organization and Equipment
W. D. G. S.	War Department General Staff
W. P. B.	War Production Board

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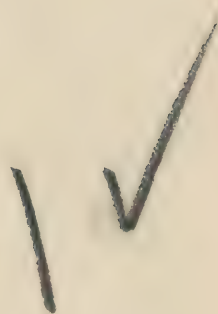
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PART II

MEDICAL DEPARTMENT VEHICLE PROGRAM



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CHAPTER V

TRUCK, 2½-TON, 6x6, SURGICAL

I. Introduction: The Armored Division.

Once the potency of the armored division had been demonstrated by the early successes of the German panzer divisions and once the counterpart of these enemy units had been adopted as an integral part of our fighting forces by the American high command, the Medical Department of the United States Army was immediately challenged to devise means to fulfill its mission of providing close medical support for the highly mobile Armored Force.

As viewed in this study, the first apparent evidence that the Medical Department quickly accepted its new responsibility is to be found in its provision of a tentative table of organization, dated 19 July 1940, for an armored medical clearing company--Table of Organization 8-78P, which was shortly superseded by the publication on 15 November 1940 of Table of Organization 8-78, Medical Company, Clearing Battalion, Armored Division.<sup>1</sup> This organization consisted of a company headquarters and two clearing platoons; and for transportation it was authorized the following standard Quartermaster vehicles:<sup>2</sup>

Motorcycle, solo	4
Trailer, tank, water, 250-gallon	2
Truck, ½-ton, command	5
Truck, 2½-ton, cargo, including	18
Kitchen (2)	
Maintenance (1)	
Personnel (14)	
Supply (1)	

It was early apparent, however, that the Quartermaster vehicles would not satisfactorily fulfill the functional requirements of the armored clearing company. Consequently, on 20 August 1941, The Surgeon General wrote in his "Foreword" to the Medical Department manual titled Research and Development Program, Fiscal Year 1942:

In the field of combat medical equipment it is essential that a medical service be developed for armored and other fast moving units at the earliest possible date. The present organization, tactics, and equipment of combat medical services have been built up around the concept of relatively static warfare. Within the past two years radical new theories and techniques of waging war

have been tested and proved. The Medical Department must keep abreast of military developments by the testing of new ideas and new techniques in order to assure an adequate and efficient medical service for all types of units.<sup>3</sup>

Later in the same report The Surgeon General included certain proposed projects whose initiation was contemplated during the fiscal year 1942, and he extensively justified their inclusion in these words:

In order to perform its function adequately and efficiently the Medical Department must be prepared to meet the new military developments occasioned by the present war. This will require not only the changing of much of its present equipment, but the development and testing of entirely new motor transport . . . at times as far forward as the casualty site. . . . Unusual means of transportation may have to be resorted to. Means of communication, protection from the elements and heat and cold, and rapid, effective treatment of the wounded . . . are required, as well as all other methods to meet the rapidly augmented tempo of modern warfare and its great distances.

The development of such a program will require close liaison with the arms and services, including the armored force. . . .

It is believed that every effort should be made to use some of the transportation now a component part of combat units, with a minimum of changes to meet Medical Department requirements.<sup>4</sup>

As will be seen more fully in retrospect later, the simple realization of The Surgeon General that research and development of new equipment would be mandatory "to meet the rapidly augmented tempo of modern warfare and its great distances" was probably of no greater significance than the note of urgency that The Surgeon General injected into this asseveration, quoted at such length, which concludes with the following advice:

In view of the fact that the Medical Department should now develop adequate and efficient material for the care of the sick and injured of the armored and other fast moving units with the least practicable delay, it has been recommended that a sum of \$225,000 for the fiscal year 1943 be appropriated for the purposes which are outlined in the proposed projects F-15 to F-22 inclusive. If this sum is forthcoming, there is a possibility that a portion of it may be made



available for use during the fiscal year 1942, on account of the urgent nature of these projects. It is therefore incumbent upon officers engaged in research and development to carefully prepare "paper plans" and full justification therefor, including fiscal estimates, to the end that work can begin immediately should 1943 funds become available this year.<sup>5</sup>

Necessity--urgent necessity--for revolutionary types of medical equipment for the Armored Force, therefore, was the prime motivator of much research and development during the months that followed. And one of the first, one of the most urgent, and--because of its wide applicability as a basis for at least four other subsequent projects--one of the most significant studies undertaken is the immediate subject of this account: Development Project F-15.03, Truck, 2½-Ton, 6x6, Surgical--"in reality a mobile clearing station inasmuch as its equipment is not elaborate and it provides space for surgical equipment within the body of the vehicle."<sup>6</sup> The development of this mobile clearing station for the Armored Force was deemed to be so urgent that at times development outstripped preliminary research, and procurement--through action that was commendable in its intent but irregular in its execution--actually antedated processes that normally would have been its prerequisites: namely, (1) development and (2) standardization.

## II. Project Initiation.

Within approximately two months after The Surgeon General had declared the existence of a critical requirement, funds needed for the initial phases of development of the surgical truck had evidently been assured; for on 16 October 1941 The Surgeon General's Office requested of The Adjutant General that "the Medical Department be authorized to initiate a project to be known as Surgical Truck for Clearing Company, Armored Force" and that the Medical Department Equipment Laboratory "be authorized to spend a sum not exceeding \$6,000 from current available funds for the development of this project."<sup>7</sup> Deviation from the prescribed routine of processing such requests through the Medical Department Technical Committee--a deviation probably indulged with good conscience by The Surgeon General's Office in an attempt, abortive though it was, to expedite the project--not only occasioned a delay of one month but also evoked, as will be seen in a moment, a directive from the War Department General Staff to get the request back into the proper channels.

The purpose of the project as announced to The Adjutant General, however, was to "Determine the feasibility of

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permanent installation of surgical equipment into a properly selected truck"--a vehicle which would have "good cross country mobility and suitable speed to keep up with the Armored Force" and for which the following military characteristics were proposed:

- a. Operating unit to be enclosed in light weight steel body.
- b. Operating equipment to be permanently installed.
- c. A 2½-Ton, 6x6, cargo truck to provide chassis for this unit.<sup>8</sup>

At the same time it was indicated that "preliminary investigation has revealed that no such project has been conducted by this [the Medical Department] or any department previously" and that "no preliminary experimental work has been done on this unit."<sup>9</sup>

Despite the expressed desire of The Surgeon General that "paper plans" be prepared, there appears to have been no research plan except what may be inferred from this letter to The Adjutant General and from a nebulous declaration relative to the 1942 plan for the prosecution of that general undertaking then designated as "Project F-15--Combat medical service for armored divisions," which had been published two months before:

#### 1942 Plan.

To study all available information upon similar developments in foreign nations, and to prepare preliminary plans for all phases of this project. To initiate actual development to such extent as is possible with funds made available, particularly with reference to observations and practices during army maneuvers.<sup>10</sup>

Having received the letter of 16 October 1941 in which The Surgeon General's Office requested of The Adjutant General authority to initiate formally the development of a surgical truck for clearing company, armored force, and realizing that the functions of the Medical Department Technical Committee had previously been preempted, the War Department General Staff, Supply Division, G-4 expressed its desire on 27 October 1941 that the proposed project "be processed through the Medical Corps Technical Committee, as required by Paragraph 9, Army Regulations 850-25".<sup>11</sup>



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From that point on, processing the proposal proceeded orderly and with no more delay than was occasioned by thoroughness. On 4 November 1941 its sub-committee recommended to the Medical Department Technical Committee, for example, that the research project be initiated and that military characteristics already enumerated be approved;<sup>12</sup> and on 17 November 1941 the Medical Department Technical Committee approved the report of its sub-committee and recommended that the project be established.<sup>13</sup>

Returning to The Assistant Chief of Staff, G-4, the original communication sent by The Surgeon General's Office to The Adjutant General requesting authority to initiate the project, an assistant to The Surgeon General on the following day reviewed the actions that had culminated in approval of the project by the Medical Department Technical Committee and informed G-4 that "Approval from your office was not obtained at this Technical Committee meeting, due to the fact that your representative was not present."<sup>14</sup>

Seemingly overlooking this implied impatience of the Medical Department to get the project formally under way and observing strictly the provisions of AR 850-25, which required coordination of any proposed development with the using arms, G-4 withheld final approval of the surgical truck project for about a month--or until it had had time to obtain from the Armored Force an expression of its opinion on the validity of the project and the desirability of its initiation.

Thus, on 27 November 1941, the Armored Force Liaison Officer in Washington, D.C., sent to Fort Knox, Kentucky, a memorandum for the Chief of the Armored Force with which he inclosed the file of "papers relative to the Medical Battalions of the armored force" and indicated that "G-4 Division, WDGS, would like your informal comment on the subjects of this communication."<sup>15</sup> Two weeks later the Armored Force replied that "In view of the fact that inclusion, in the proposed table of organization for the Medical Battalion, Armored Division and the Medical Regiment, Armored Corps contemplates the utilization of a truck with inserts, adapted to the purposes of a forward surgical unit to be operated by Composite Medical Combat company personnel," the research project "presented for . . . surgical trucks should be initiated without delay."<sup>16</sup> The Armored Force--which had already experimentally developed a similar surgical truck, as will be seen in a moment--further expressed its desire that the following points in addition to the military characteristics approved by the Medical Department Technical Committee be considered in the development of the surgical truck for the Armored Force:

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a. Maintenance of flotation and maneuverability of the 2½-ton, 6x6, Cargo Truck by avoiding construction of a too heavy body or high silhouette.

b. Development of a light trailer designed to carry a generator for light, heat, and sterilization.

c. Separation of the driver's cab in its entirety from the body of the truck.

d. Gas proofing.

\* \* \*

g. Inclusion of some attachment on tops of unit to permit erection of paulins between units as shelter for unit personnel or patient overflow.<sup>17</sup>

A parenthetical--though only momentary--digression is appropriately suggested by this last recommendation. A tent finally was developed for use with the surgical truck. Since its development--though accomplished only after continuous liaison with the Medical Department--was technically a Quartermaster project, references made to the surgical tent in this account are only incidental.

The War Department General Staff, G-4, having been assured by the Armored Force that the proposed development of a surgical truck was not only desirable but also urgent, The Adjutant General, on 30 December 1941, gave his final approval and directed that "Standard Quartermaster vehicles will be utilized" in this project.<sup>18</sup>

Receipt by The Surgeon General of this directive at year-end effectively terminates what may be considered as the phase of project initiation. The fact that the correspondence was forwarded by The Surgeon General's Office to the Medical Department Equipment Laboratory for its information and for attention to the comments of the Armored Force<sup>19</sup> is added only as a footnote to the significant suggestions made at Fort Knox, to which action the Director, Medical Department Equipment Laboratory, however, replied simply with the routine cliché: "Noted and returned in compliance with preceding endorsement."<sup>20</sup>

### III. Development Phase.

#### A. Improvisation of First Armored Division.

Formal approval of the proposal to develop a surgical truck for the Armored Force was finally received, then, during the closing hours of 1941. That the Armored Force should have promptly concurred in such a proposal or that it should

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have been ready with concrete suggestions is easy to understand, for the 47th Medical Battalion of the First Armored Division had several months previously constructed an experimental surgical truck very similar to the one now proposed for formal development. (See Figs. 21 and 22.)

Just when the First Armored Division unit had constructed its experimental model is not revealed in the correspondence under review. But because photographs of it, official photographs of the Armored Force Board,<sup>21</sup> are dated 25 July 1941 and thus antedate by nearly three months formal initiation of the development project and by nearly a month, even, publication of The Surgeon General's Research and Development Program, Fiscal Year 1942, it would appear that no little credit for developing the surgical truck should go to the 47th Medical Battalion of the First Armored Division.

In the form of correspondence, the first apparent evidence that the Armored Force had been experimenting with the construction of surgical trucks came on 7 January 1942. On that day an assistant to The Surgeon General sent a memorandum to the Finance and Supply Division, Surgeon General's Office, in which he reported that on the preceding day the General Staff Liaison Officer for the Armored Force had telephonically indicated that "the 1st Armored Division will require, by February 1, 1942, six (6) surgical trucks as provided in recently approved revision of tables of organization for The Armored Force."<sup>22</sup> He further reported that "The 1st Armored Division has experimentally constructed such a truck using the standard 2½-ton, 6x6, chassis" and that the Surgeon of the Armored Force had revealed by telephone that if The Surgeon General's Office would "provide funds, not to exceed \$3000.00, the Armored Force at Fort Knox, Kentucky, will construct the bodies necessary to complete the requirement"; and he recommended, finally, that

In view of . . . the short time available to fabricate or procure these bodies, except as stated above, . . . funds, in the amount of \$3000.00, be made available to The Armored Force, Fort Knox, Kentucky, for the purpose of fabricating bodies to provide the needed surgical trucks for the 1st Armored Division at that station.<sup>23</sup>

Although as a result of the emergency the \$3000 was granted,<sup>24</sup> a subsequent request of the Armored Force for \$20,000 with which to construct locally similar equipment for four more of its divisions<sup>25</sup> was, for reasons which will be examined later, disapproved.<sup>26</sup>

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B. Preliminary Planning and Initial Designs.

Authorization of Development Project F-15.03 having reached both The Surgeon General's Office and the Medical Department Equipment Laboratory before the end of the first week of January 1942, formal development could proceed. But despite the fact that The Surgeon General, as has already been noted, had recommended the preparation of "paper plans" so that there might be no delay once approval of this and certain other contemplated projects had been received,<sup>27</sup> little anticipatory labor--on this project, at least--had been expended. Thus, mainly generalizations were forthcoming when, on 18 January 1942, the 48th Armored Medical Battalion, with the 2d Armored Division at Fort Benning, Georgia, made the following request of the Medical Department Equipment Laboratory:

1. We are very desirous of having a plan or plans, which you may have developed, for the construction of a Surgical Truck, we apparently being required to construct our own. Realizing that you have been working on this plan for some months, we would like any suggestions you may have to offer by return mail.<sup>28</sup>

By indorsement dated 21 January 1942, the officer replying for the Medical Department Equipment Laboratory stated that

1. . . . we have only just received authorization on the above project and while we have given it some thought we have not as yet progressed very far. I have just returned from Ft. Knox, Ky., where I had been to get some ideas as to limits of the size of the body.

2. The standard 2½-ton, 6x6 chassis is to be used and it appears we can develop a body about 13 ft. long, 88 inches wide, 76 inches high. The equipment and arrangement therein have not been worked out. It is stated that the arrangement made at Ft. Knox works quite well, and I believe if you will write Major L. Holmes Ginn, M. C. he will be able to send you photographs of their layout together with their canvas arrangement. Their water supply, I believe, is too great and can be greatly reduced. I am very sorry that I am unable to give you any suggestion as to value at this time.<sup>29</sup>

It is apparent from the first, then, that the Armored Force, which had itself improvised a surgical truck by fitting

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a special body onto a standard Quartermaster vehicle, was to play a significant role in the formal development of the Medical Department's Truck, 2½-ton, 6x6, Surgical. Close coordination among The Surgeon General's Office, the Medical Department Equipment Laboratory, and the Armored Force--not to mention the Quartermaster (later Ordnance) Department, whose interest in the project cannot be minimized since the basic vehicle was a Quartermaster item--was therefore to be expected.

### C. Early Development.

The Surgeon of the Armored Force, cognizant of his organization's dire need for the equipment, was eager to speed the project along, for on 13 January 1942--just two weeks following formal authorization of the project--he wrote The Surgeon General for information "as to progress being made in initiation of production of truck, 6x6, 2½-ton, special operating body."<sup>30</sup> Since development by that time could not have progressed much further than a very tentative planning stage, this request for information on production seems a little unreasonable. But despite that fact, by re-emphasizing the Armored Force's needs his letter may have been instrumental in accelerating development. In any event, on 26 January 1942, the Director of the Medical Department Equipment Laboratory, recalling that authority for the project had been received by the Laboratory on 5 January 1942, reported that

Preliminary drafting of possible type bodies for standard 2½-ton, 6x6 chassis, was accomplished and taken to Fort Knox by the undersigned when the matter of clearance, overall height, etc., were discussed with the Surgeon, Armored Force, and the Surgeon, 1st Armored Division, also with 1st Armored Division Equipment Board. Based upon these discussions, we are now working on body plans and equipment layout and hope to be able to begin actual construction in a short time.<sup>31</sup>

Foresight was demonstrated from the very first in the development of Project F-15 (which covered generally combat medical service for the Armored Force) when it was decided to design the body for the surgical truck as a multiple purpose van body "suitable for nearly all Medical Department Mobile units except ambulances and ward trucks."<sup>32</sup> Of considerable importance, then, is the statement in the Medical Department Equipment Laboratory's Monthly Progress Report for January 1942: "The design of a multiple purpose van body to be mounted on a 2½-ton, 6x6 cargo truck was completed"; and satisfactory progress is to be observed in the further statements that "Design of the interior equipment of the surgical

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truck to be installed in the multiple purpose van body was begun" during January and "It is estimated that this design will be completed and will be submitted to The Surgeon General about February 7, 1942."<sup>33</sup>

Fulfilling this prophesy to the day, the Director of the Medical Department Equipment Laboratory forwarded to The Surgeon General on 7 February 1942 copies of the Equipment Laboratory drawings and specifications covering the design and construction of both the multiple purpose van body and the interior equipment for the surgical truck. He pointed out at the same time that

Inasmuch as the construction of several different Mobile units (such as the Surgical Truck and the Mobile Aid Station for the armored force and Medical and Dental Laboratories for Corps and Army) has been authorized, the first consideration was the design of a suitable body that could be used for all of these units. From a standpoint of production and procurement the advantages of standardizing on a single body style is obvious.

The 2½-ton, 6x6, light chassis, with the long (164 inch) wheelbase was selected as being the most satisfactory chassis in current production.<sup>34</sup>

Indicating further the desire of the Medical Department Equipment Laboratory to secure one complete surgical truck as a pilot model and the fact that funds for payment were available, the Director of the Equipment Laboratory concluded with a recommendation to The Surgeon General that "the inclosed drawings and specifications if approved be forwarded to the Holabird Quartermaster Depot for the purchase of one (1) complete Surgical Truck."<sup>35</sup>

But before The Surgeon General's Office could legitimately approve, the design proposed by the Equipment Laboratory had to be coordinated with the using agency, the Armored Force. Some three weeks later, consequently, The Surgeon General's Office routinely forwarded the documents drafted by the Medical Department Equipment Laboratory to Headquarters, Armored Force, Fort Knox, Kentucky, with the indorsement: "For comment and recommendations. Please expedite."<sup>36</sup>

The Armored Force complied more promptly than The Surgeon General's Office had acted. Hardly a week had elapsed when, on 12 March 1942, came suggestions<sup>37</sup> from the Armored Force indicating its desire that the Equipment Laboratory tentative specifications be revised to provide for the following:



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1. Open instead of closed cab.
  2. Battery charger, as contained in Appendix A, T/BA #17.
  3. An air conditioning unit "for the protection of patients and medical personnel in hot climates" inasmuch as "No provision appears to have been made for cooling or forced ventilation."<sup>38</sup>
  4. Outside electrical outlets.
  5. Means of draining the water tank.
  6. A red cross, without white background, to be painted on the side but not on top of the truck, although such action "may be a contravention of the Geneva Convention."<sup>39</sup>

In regard to these Armored Force comments, which had been forwarded to him by The Surgeon General's Office for his information, the Director of the Medical Department Equipment Laboratory replied in detail:

1. With reference to the comments of the Armored Force contained in the 3rd Indorsement the following is submitted:

a. It is not considered necessary to revise the drawings and specifications to provide for an open cab. This matter will be taken up by the Equipment Laboratory direct with the Holabird Quartermaster Depot at the time the pilot model is procured. Naturally, if only open cab model trucks are being procured for the Armored Force the Quartermaster will procure this model.

b. If desired by the Armored Force a battery charger can be carried with the unit. No attempt was made by the Equipment Laboratory to provide a stock list of equipment for the surgical truck. The battery charger should appear on the stock list along with the operating table, drugs, dressings, and other issue items; it does not belong in the specification.

c. Provision has been made for force ventilation of the unit. The Evans Model HV-203002 combination heater provides fresh air circulation when not used as a heater. Introduction of an air cooling or

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conditioning system is not considered practical for a front line unit. An air cooling and conditioning unit for a truck body of this size would be large, bulky, intricate and would require considerable electricity for its operation.

d. There is no purpose in installing outside electrical outlets. The unit is wired for six volt battery current. Should it be desired to use the battery charger recommended in Paragraph 1b, Third Indorsement this charger would be connected directly across the terminals of the truck battery when in use. The vehicle was not wired for 110 volt commercial house current inasmuch as it is inconceivable that such current would be available at the location where the surgical truck is to be used. However, if such current were available the truck could be lighted by running a couple of drop cords with electric lights into the vehicle.

e. It is possible to drain the water tank without undue difficulty or unusual ingenuity. This is accomplished by opening either the hot or cold water tap of the sink.

f. The Equipment Laboratory was directed by The Surgeon General's Office to mark all Medical Department vehicles in strict accordance with the Geneva convention.

2. a. Inasmuch as the criticisms of the Armored Force as contained in the 3rd Indorsement were of a minor nature and in no way affect the general principle of the surgical truck, it is recommended that the drawings and specifications as prepared be forwarded to the Holabird Quartermaster Depot for the procurement of one pilot model of this vehicle.

b. After field test of the pilot model by the Armored Force consideration should be given to changes or modifications recommended by them before mass procurement of the vehicles is begun.<sup>40</sup>

The Surgeon General's Office approved the Equipment Laboratory's recommendation that the Holabird Quartermaster Depot procure one pilot model of this truck in accordance with the drawings and specifications as prepared originally

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by the Medical Department Equipment Laboratory, and it immediately notified The Quartermaster General of concurrence by The Surgeon General in this proposal.<sup>41</sup>

This decision of the Medical Department to get on with the procurement of the pilot model having been made during the last days of March, The Surgeon General was informed in the Monthly Progress Report of the Medical Department Equipment Laboratory for April 1942 that during April a conference had been held "between the representative of the Equipment Laboratory and representatives of the Engineering Section, Holabird Quartermaster Motor Base, to decide upon the principal characteristics of the surgical truck" and that "It was agreed that procurement of one pilot model vehicle would be accomplished by the Holabird Quartermaster Motor Base substantially in agreement with the specifications submitted to them by this Laboratory."<sup>42</sup>

More specifically, as a result of this liaison the following agreements were reached:

1. The body cannot be shorter than thirteen (13') feet to provide sufficient room for a concurrent recovery patient and a surgical case.

2. The chassis frame to be extended one (1') foot to locate the pintle and bumpers in their relative positions with respect to the rear of the body.

3. The load to be carried in the body during transportation will not exceed 3000 pounds.

4. The chassis extension to be effected by the body builder. Chassis are to be delivered standard 164" wheelbase from the chassis producer's production line.

5. Holabird Quartermaster Motor Base will prepare the specifications covering the completed unit, which will be furnished by the body contractors as described in the specifications provided by the Equipment Laboratories, covering the body and Interior Equipment.

6. The pilot model will be the unit required by the Armored Force and has been tentatively approved by them from experiments conducted with a similar unit constructed on

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a 2½ ton twelve feet long cargo body.

7. Equipment Laboratories representatives desire to inspect the body during construction, as well as when the complete unit is ready for delivery.<sup>43</sup>

A month later, The Surgeon General's Office notified the Armored Force of this conference, saying that on 20 April 1942 the "Director of the Medical Department Equipment Laboratory . . . went to Holabird to inspect and coordinate the manufacture of the Surgical Trucks for the Armored Force" and reporting further that "Holabird is still working on this project and at this time no definite answer could be given as to when we would receive the trucks."<sup>44</sup>

Meantime--very shortly after the Holabird conference--The Surgeon General's Office had forwarded to the Director of the Medical Department Equipment Laboratory, for his information and remarks, correspondence which had just arrived from the Office of the Surgeon, Armored Force. This correspondence transmitted plans, characteristics, and photographs of the improvised surgical truck, which had been designed by the First Armored Division and of which six units had been constructed locally with the \$3000 recently made available by The Surgeon General.<sup>45</sup> The Director of the Equipment Laboratory, however, was not favorably impressed by the plans of the improvisation:

1. The inclosed drawings and specifications of the Surgical Truck constructed by the First Armored Division have been examined by the Engineers in the Equipment Laboratory.

2a. The body appears to be a rather fragile construction for field service and being built above the regular cargo body of the 2½-ton truck results in a rather high silhouette.

b. It is realized that adequate facilities for the construction of this vehicle were probably not available.

3. It is believed that the essential features of this design have already been incorporated in the Equipment Laboratory and now under procurement by the Holabird Quartermaster Motor Base. Additional features included in the design by the Equipment Laboratory which apparently are not incorporated in the vehicle constructed by the First Armored Division are:



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- a. All steel body.
- b. Relatively low floor height resulting in easy access to the vehicle and a lower overall height.
- c. Insulated walls, roof, and floor.
- d. Combination gasoline, kerosene, fuel oil or wood burning heater which also provides for fresh air circulation when not used as a heater.
- e. Elimination of the detachable rear ladder by providing a rear step that folds into the door when not in use.<sup>46</sup>

D. Concurrence of Procurement with Development.

Under more normal conditions one would probably have judged that the development of the surgical truck was proceeding as expeditiously as possible; but conditions in the spring of 1942 were not normal. Daily the necessity of having more and more men and their equipment ready to be committed in preponderant number to both the actual and the proposed battlefronts of the world was becoming more imperative. The time was fast approaching, as subsequent events revealed, when the armies of the United States were to mount the offensive. Knowing the role that certain of the armored divisions were to play in this changing military design, the Armored Force was growing impatient. It needed the surgical trucks. It wanted them at once. It could afford no further delay.

And so, on 30 May 1942, the Commanding General of the Armored Force sent the following telegram to The Surgeon General: "INFORMATION IS REQUESTED AS TO WHEN DELIVERY OF SURGICAL TRUCKS FOR THIRD FOURTH FIFTH AND SIXTH ARMED DIVNS MAY BE EXPECTED."<sup>47</sup> A record of The Surgeon General's direct answer has not been found; but the Monthly Progress Report of the Medical Department Equipment Laboratory for the period 1 May 1942--9 June 1942 indicated that

The Holabird Quartermaster Motor Base is in the process of procuring one pilot model surgical truck in accordance with the design of the Equipment Laboratory. A letter was written to the Holabird Quartermaster Motor Base June 2, 1942, inquiring as to the exact status of this project. No reply has been received to date.<sup>48</sup>

With no assurance that the trucks were to be delivered promptly, the Surgeon of the Armored Force on 18 June 1942 requested through channels that The Surgeon General allocate to the Armored Force \$20,000 for the local construction of twenty-four surgical trucks--enough to equip the four armored divisions

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named in the telegram just cited. "The exigencies of the situation, as they pertain to these divisions," the Armored Force explained, "are such as to preclude further delay in the procurement of these vehicles."<sup>49</sup>

In its 1st Indorsement of this request, however, Headquarters, Army Ground Forces, recommended disapproval of the proposed allocation "provided the surgical trucks referred to will be ready for distribution prior to August 15, 1942"; otherwise, "if there is any question as to the availability of these trucks for distribution by that date, it is believed that the request should be approved."<sup>50</sup> Pointing out that its latest information was that the pilot model would be available "on or before July 10, 1942," and that manufacture was to begin 1 August 1942, the Army Ground Forces added that "It is not believed that the Armored Force could construct 24 surgical trucks locally prior to August 15, 1942," and concluded with the suggestion that, since the need for these vehicles was so urgent, "every available short-cut be taken to assure their early procurement."<sup>51</sup>

In its turn Headquarters, Service of Supply, disapproved of "recommendation contained in basic letter" because

The office of The Quartermaster General . . . informs this office that pilot model for subject vehicle will be available . . . by July 12, 1942. The construction of the twenty-four (24) surgical trucks will begin after the acceptance of the pilot model and delivery is expected by August 15, 1942.<sup>52</sup>

This chain of correspondence was then forwarded to the Director of the Medical Department Equipment Laboratory for his information and was later indorsed back by The Surgeon General's Office to Headquarters, Armored Force, without approval.<sup>53</sup>

Although a month was required for this correspondence to travel the route indicated, the Surgeon of the Armored Force approximately three weeks in advance had learned informally of the likely disapproval of his proposal to construct the trucks locally. One day prior to initiating his formal request for the \$20,000 he had written a personal letter to an officer in The Surgeon General's Office asking for "the latest dope on our surgical trucks and the black-out tents that go with them" and commenting that "we have got to get those things without further delay, in view of recent developments concerning the employment of certain units of the Armored Force."<sup>54</sup>

Albeit the officer to whom this letter had been directed went on leave shortly after he received it, he did

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instruct one of his assistants to furnish the information desired. Consequently, just after 24 June 1942, the Surgeon, Armored Force, received from the assistant a personal letter which read in part as follows:

Now, as for the latest dope on the Surgical Trucks. I first contacted the Quartermaster General's Office who told me that after they had been on the drawing board for a long period of time, the Headquarters, Services of Supply, had requested that they be sent to them. I then contacted the Headquarters, Services of Supply, Developments Branch, Requirements Division and they now have the complete drawings and indorsements on the case. I believe we can look for some early action now that Headquarters, SCS, has taken hold of it.

It seems that they were short-circuited before and did not know anything about the case until recently. Major Kleff /in Headquarters, Services of Supply/ assures me that the pilot will be at Carlisle /i.e., at the Medical Department Equipment Laboratory/ by July 10th, and that standardization and all action will have to be complete by August 1st, so that we can go into procurement at that time.

The Army Ground Forces just phoned me and stated that they had received a request from Headquarters Armored Force for \$20,000 to develop these trucks locally. I referred them to Major Kleff and he has requested that these papers be sent to him. I do not believe that Headquarters, SCS will agree to the local development of these trucks since they have progressed to the stage that they are now in.<sup>55</sup>

This letter is quoted so fully not only because it explains one reason for an exceedingly important if short-lived delay in the development of the surgical truck, but also because it accounts for the directive that threw the machinery of development and subsequent procurement again into high gear. This directive, written the same day as the letter just quoted--24 June 1942--took the form of an indorsement from Headquarters, Service of Supply, to The Quartermaster General and runs as follows:

1. The Quartermaster General will complete the specifications and construct the pilot model of the proposed surgical truck prior to July 10, 1942. Direct communication with The Surgeon General is authorized and will be maintained to expedite this matter.

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2. The pilot model will be tested at Carlisle Barracks /i.e., at the Medical Department Equipment Laboratory/. Such tests as are conducted will be expedited with a view toward standardization and quantity procurement initiated prior to August 1, 1942.

3. Every effort will be made to expedite this matter.

Almost immediately after the promulgation of this directive, the Office of The Surgeon General informed the Surgeon, Armored Force, of this turn in events and of the apparent solution to other problems incident to the rapid development and production of the surgical truck. Noting the inclosure of a copy of the directive, the officer sending this information prefaced his comments with this observation: "It looks as though we are getting action at last on this truck."<sup>57</sup>

Then follows a report that "The York Hoover Company in York, Pennsylvania is going to construct the pilot model" and that the Director of the Medical Department Equipment Laboratory

is going to be Liaison Officer so that any minor difficulties can be ironed out at the time of construction. This should save time and make the pilot model, as nearly as possible, the production model so that we can get into production as soon after July 10th as possible.<sup>58</sup>

The writer further reported that he had

conferred with the Quartermaster General's Office today and this concern was the only one who could consider taking on the pilot model. They would only take the pilot model if we gave them a letter of intent for twenty-four (24) of the trucks. After receiving approval from Headquarters Services of Supply, the Quartermaster is going to do this.<sup>59</sup>

To the Director of the Medical Department Equipment Laboratory, too, was sent a similar letter which inclosed a copy of the directive; informed him that the York Hoover Body Company would build the pilot model only if they received a letter of intent to purchase twenty-four trucks, although "They are so busy with other things that they did not want to bother with it at all"; and notified him that "a new directive will be out probably today and you will be asked to confer as liaison with the York Hoover Company so that except for minor changes, a pilot model can be, as nearly as possible, the production model."<sup>60</sup>

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On the following day, 27 June 1942, the Director, Requirements Division, Services of Supply, formally authorized The Quartermaster General "to issue a letter of intent to the York-Hoover Body Company, York, Pennsylvania, for the purchase of twenty-four (24) Surgical Trucks, pending the satisfactory acceptance of their pilot model"<sup>61</sup> and, by separate communication reiterating that "Every effort will be made to expedite this matter," simultaneously directed The Surgeon General to "appoint a liaison officer with the York-Hoover Body Company during the construction of the pilot model of the Surgical Truck, in order to expedite the testing, standardization and quantity procurement" of this vehicle.<sup>62</sup>

Despite all this expeditious and expediting action, another delay--though fortunately a short one--abruptly occurred. On 2 July 1942 a letter to the Surgeon, Armored Force, explained the brief delay thus:

After the York Hoover Body Company received a letter of intent from the (ffice of the Quartermaster General for twenty-four (24) of the Surgical Trucks, they rejected the contract and declined even to build the pilot model. For the past two days, the Quartermaster General's (ffice has been in touch with a number of firms who build truck bodies.<sup>63</sup>

The names of six firms other than the York Hoover Company that had been approached were listed, followed by the declaration that the Krieger Steel Section, Incorporated, 11-11 34th Avenue, Long Island, New York, had finally accepted and "promised to have the pilot model at Carlisle by July 11th."<sup>64</sup>

After Krieger had accepted the contract, Headquarters, Services of Supply, was formally notified of the appointment by The Surgeon General of the Director, Medical Department Equipment Laboratory, as Liaison Officer to "act in conjunction with the Creiger [sic] Steel Section, Incorporated, . . . instead of the York Hoover Body Company, who refused the contract."<sup>65</sup> And two days later Headquarters, Services of Supply, formally confirmed for The Quartermaster General a telephonic authorization "to use twenty-four (24) of the thirty-two (32) 2½-ton, 6x6 chassis released by the Chemical Warfare Service July allocation of 2½-ton trucks"--such chassis "to be used for the Armored Force surgical vehicles that are urgently needed."<sup>66</sup> Thus it will be observed that from this point, because of the exigency of the situation, development and procurement for a time proceeded concurrently and that procurement, indeed, was actually initiated prior to standardization or even developmental testing of the surgical trucks.

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E. Construction and Delivery of Pilot Model.

With the drawings and specifications completed, the supply of chassis assured, the contract for both the pilot and production models let, and a liaison officer appointed, the machinery of further development and production appeared well oiled and ready to roll. Consequently, as requested by the Krieger company, the liaison officer on 6 July 1942 visited the plant for a conference to clarify certain questions relative to the drawings and specifications;<sup>67</sup> and supplementary and additional information, requested by telephone, was supplied by letter from the Equipment Laboratory two days later.<sup>68</sup> Evidence of the success of this conference as well as an indication that plans were being drawn to obviate any further delay are apparent in a letter from the Equipment Laboratory on 8 July 1942, informing the Armored Force of the current status of the project:

At last we are about to get a pilot model of the surgical truck. It is supposed to be here by July 10, but my representative just came back from the factory and states that he doesn't believe they can have it by that time but won't be far off. Now our directive is to test this and get same standardized and ready for procurement by August 1, 1942.

There will be some work and installation to be done here and perhaps some changes. Now as your organizations are primarily concerned, I am writing this to ask, if possible, that you send a representative here to us in making any desired changes especially in internal arrangements, also on installed equipment so that we will all be better satisfied. Your representative should be here around the 15th and be prepared to stay a few days.<sup>69</sup>

Despite the fact that development of the surgical truck was progressing with speed, the letter just cited bears evidence of an increasing awareness that construction of the pilot model could not be completed by the date set by the Services of Supply directive: namely, 10 July 1942. The Monthly Narrative Report of the Medical Department Equipment Laboratory similarly indicates that a further slight delay was anticipated, for it states:

It is expected that the body of this truck will be completed on July 13, 1942, and that the interior equipment which is to be furnished by various other companies will be installed and delivery made between the 15th and 20th of July 1942.<sup>70</sup>

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The truck was actually delivered to Carlisle Barracks on 18 July 1942.<sup>71</sup>

F. Tests of Pilot Model and Changes Proposed by Medical Department Equipment Laboratory.

Neither the nature of the tests that followed nor the completeness with which they were conducted is definitely known, for the usual formal report of this activity seems not to have been drafted. Perhaps it was omitted because, as will be recalled, Headquarters, Services of Supply, in providing that the pilot model be tested at Carlisle Barracks, had directed that "Such tests as are conducted will be expedited with a view toward standardization and quantity procurement initiated prior to August 1, 1942."<sup>72</sup> Nevertheless, notes in the files of the Medical Department Equipment Laboratory indicate that a conference among representatives of Krieger Steel Sections, Holabird Quartermaster Depot, and the Medical Department Equipment Laboratory was held at Carlisle Barracks on 21 July 1942 and that certain changes--which with one exception were substantially like those to be cited in a moment--were concurred in.<sup>73</sup>

Once the conference was ended, the Medical Department Equipment Laboratory immediately made known the results of it to the Armored Force, whose representative had inspected the pilot model, though he apparently was not present at this conference: "We have just completed the road testing of the Surgical Truck and find that it performs quite well."<sup>74</sup> Being informed of the conference held the day before, the Surgeon of the Armored Force was also told that

The only changes we are making in the body is the relocating of the spare tire and the elimination of the apron which had no value except for appearance.

This latter change insures that the body will clear anything the frame will behind. New drawing in duplicate showing body design is inclosed. We believe there is ample clearance behind as we have a thirty-one degree angle of departure to the rear frame. The bumper spade cuts this a little but the spade will cut through readily and we left it as is as it gives more bumper space.

We are rewiring the body leaving only two dome lights on the battery circuit, so you can requisition your Homelight small generators and also the operating tables.

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In order to get production under way and to have your units by August 15 as I have been directed, I have given the Company the go ahead signal on the bodies and I understand that the Quartermaster has already delivered seven chassis to the firm.<sup>75</sup>

Just a week later the Armored Force gave its approval of the body of the vehicle but objected to one of the other changes that had been recommended, namely, subdivision of the cabinets as detailed in Appendix C:

I received today the blueprints and specifications on the surgical truck. I think, with the changes indicated, that it is going to be satisfactory insofar as the general construction of the body is concerned.

However, I do not like those small compartments in the cabinets. They should be large enough to receive items of unit equipment, such as surgical sets, and deep enough to accommodate shell dressings, other dressings, linens, etc.

Those little drawers remind me somewhat of a hardware shop which utilizes similar drawers for keeping different sizes of nuts and bolts. They are too small for any practical purpose.

I am submitting these plans immediately to the Armored Force for their approval; which, I think, will be forthcoming. I will advise you just as soon as I get the green light. Time is indeed of the essence, and production of the twenty-four trucks on contract by August 15th, as I understand it, will not be affected by any change that may be directed by the Armored Force. After the initial contract has been satisfied, if the Armored Force desires changes other than those mentioned, a new contract will, of course, have to be initiated.

Thanks for your efforts in our behalf.<sup>76</sup>

The Director of the Equipment Laboratory agreed only partially with the Surgeon of the Armored Force in his criticism of the cabinets; nevertheless, he instructed his representative then at the factory that "if not too late . . . one-half of the small drawer cabinets on the one side be changed to one cabinet with shelves."<sup>77</sup> The Director still felt, however, that even without changes the cabinets would

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"work out all right," since "In the present set-up . . . there are at the rear several drawers long enough and deep enough to take instrument cases and packs, also a large cabinet on one side" and since there could be made available enough additional shelf space for all linen and packs once the present plan for "moving the wash basin over in front" was executed.<sup>78</sup>

This change was apparently decided upon after the conference of 21 July, for the notes on that conference, presented in Appendix C, indicate that the mixing faucet and sink were to remain unchanged.

Simultaneously, several additional changes in plans were also explained. "We have had to add a small water heater," the Equipment Laboratory told the Armored Force, "as the coil in the Evans heater presented the difficulty of giving heat to the truck if operated for hot water, and also in cold weather when operating for heating the truck, it produced too much hot water and steam"; furthermore, "We have revised it and made provisions for portable light inside (other than the operating light) which will be the same as the outside tent lights and can be hung in several places inside of direct light [sic] where needed."<sup>79</sup> The Director of the Equipment Laboratory seemed well pleased with the product that had been developed, for although he conceded that "There may be minor changes necessary which can be found out only when [the truck is] put to use in the field," he believed that "this truck will do the work."<sup>80</sup>

As a consequence of the decisions reached by representatives of the manufacturer, the Holabird Quartermaster Motor Base, and the Medical Department Equipment Laboratory in the conference at Carlisle Barracks on 21 July 1942 and as a result of having coordinated these decisions with the Armored Force, the Director of the Equipment Laboratory sent the following letter to The Surgeon General on 1 August 1942 to inform him of the changes which were desired in the production models:

1. Subject contract with the Krieger Steel and Iron Works, Inc., 11-11 Thirty-Fourth Avenue, Long Island City, N. Y., covers the procurement of twenty-four (24) Medical Department Surgical Trucks in accordance with the pilot model delivered to this station July 18.

2. Inspection and tests of the pilot model by the Equipment Laboratory and representatives of the Armored Force had indicated the desirability of making certain changes and additions to the production vehicles not called for in the original

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specifications. These changes will involve additional expense to the vehicle manufacturer and are as follows:

a. Install 5 gallon hot water tank and gasoline operated hot water heater in accordance with Equipment Laboratory Drawing No. C-357 and SK-52.

b. Install complete 110 volt wiring system in accordance with Equipment Laboratory Drawing No. SK-51.

c. Vehicle manufacturer to supply six (6) gooseneck lamps in accordance with samples furnished by the Equipment Laboratory. Provision to be made for mounting four (4) of these lamps on the outside of the vehicle in the location shown on Drawing No. F-358 and two (2) of the lamps on the interior wall, forward of the parcel rack.

d. Provide one (1) funnel in accordance with sample furnished by the Equipment Laboratory, with each truck for filling water storage tank.

3. The following changes and modifications not involving any additional expense to the contractor are to be made on all production models:

a. The water heating coil to be eliminated from the Evans vehicle heater.

b. All Evans heater fans to be operated from 110 volt 60 cycle alternating current.

c. Body skirting to be eliminated.

d. Spare tire to be located on the left hand side of body in accordance with instructions furnished by the Holabird Quartermaster Motor Base.

e. Filler neck on gasoline tank to provide easy access.

f. Install removable service plate for the folding rear stop mechanism on each rear door.

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g. Install shelves in wood cabinet at front of truck.

h. Close left end of wood cabinet and install divider in center.

i. Flat rim sink to be installed at extreme left end of wood cabinet as shown on Drawing No. 4257, revised.

j. Contractor should check the rear windows to be sure there is sufficient space for the installation of black-out curtains; if necessary decrease size of window.

k. Steel ladder to be installed on body in accordance with Equipment Laboratory No. F-358.

l. Install parcel racks in accordance with original specification.

m. Steel cabinets to be in accordance with latest revisions of Medical Department Equipment Laboratory Drawings No. 2258, 4259, 3260, 3261, 2263, D-295, D-296, D-297 and D-298.

4. The Krieger Steel Sections, Inc., have been notified of all changes and modifications listed in Paragraph 2 and 3. They have also been furnished the latest revisions of Equipment Laboratory Drawings referred to above as well as samples of the water heater, filler funnel, and gooseneck lamps.

5. Inclosed herewith in duplicate Equipment Laboratory Drawings No. 2258, 4259, 3260, 3261, 2263, D-295, D-296, D-297, D-298, SK-51, SK-52, 4257, C-357, and F-358.

6. The Purchasing and Contracting Officer, Holabird Quartermaster Motor Base and the Krieger Steel Sections Inc., are being furnished copies of this correspondence. 81

G. Description of Pilot Model Surgical Truck.

The pilot model of the surgical truck, at this stage of its development, consisted of a van body--estimated to weigh, with equipment, 2400 pounds--which was based on a standard 6x6, 2½-ton truck. (See Fig. 23.) Mounted within the van body, which was wired for six-volt current only, were a 50-gallon

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water tank; an air-circulating fan; a sink with hot and cold water outlet; cabinets for equipment, supplies, and accessories; and three six-volt dome lights, two general purpose and one operating. (See Fig. 24.) Other equipment was Medical Department issue and was to be installed in accordance with specifications prepared by the Medical Department Equipment Laboratory.

Outside the van body were a combined air-water heater on the left front of the body; a six-gallon gasoline fuel tank for the air-water heater, located above and to the right of the cab; and electrical connections for a generator or other source of current. A tent spacious enough to shelter as many as 20 litter patients was designed to be stretched over the truck and to be extended both to the sides and to the rear.

This was the vehicle which had been so urgently desired by the Armored Force and which the Armored Force Board now had an opportunity to test.

#### H. Tests Conducted by Armored Force Board.

Before the end of August the pilot model of the surgical truck had been sent first to the Quartermaster Depot, Jeffersonville, Indiana, "to provide a proper model over which is to be fitted a surgical tent as designed by the Armored Force,"<sup>82</sup> and then to Fort Knox, Kentucky, "for work in connection with standardization of this vehicle for the Medical Company, Armored Battalion."<sup>83</sup> At Fort Knox tests involving cross-country operation, pitching and striking of tent, black-out characteristics, and inspection by Armored Force Medical Officers and demonstrations to Medical personnel were conducted "to determine the suitability of the surgical truck and tent for the Armored Force."<sup>84</sup>

The Armored Force Board was generally very favorably impressed with the surgical truck and, incidentally, with the Quartermaster-developed tent. With an eye on the cross-country characteristics of the truck itself, for example, it observed that "the truck is well under its payload capacity" and that "the truck has excellent cross-country ability, equal to that of the standard 2½-ton, 6x6, truck," although "The added height of the van body (approximately one and one-half (1½ feet) will cause some difficulty when travelling through wooded areas."<sup>85</sup>

Accessories, equipment and facilities on or within the body of the truck, too, were found to be adequate except that they left the following features to be desired:

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1. Provision for external sources of electricity with the consequent rewiring of the truck for 110-volt current;
2. Wiring for current available from the truck power supply as well as from external sources;
3. Four brackets on the outside of the truck body to facilitate lighting of the tent;
4. Outlets within the body;
5. An additional ventilating fan or, as an alternative, separate air and water heaters;
6. Larger drawers on certain cabinets;
7. More substantial and more readily operated drawer latches;
8. Improvement of the latching device on burner-lighting door of air-water heater;
9. Improvement of spring-operated draft-regulating door of heater;
10. More rugged and better protected fuel metering valve assembly;
11. Factory-installed brackets for attachment of tent straps; and, finally,
12. Relocation of sink drain pipe.<sup>86</sup>

Although many of these changes, it will be observed, were of a very minor nature, one in particular--external outlets for 110-volt current--had been desired from the beginning, though the Armored Force suggestion that it be provided had, at first, been rejected by the Director of the Medical Department Equipment Laboratory.

Evidence of its satisfaction over results of the tests is seen in the fact that the Armored Force Board, on 26 August 1942, recommended that "The truck, surgical, 2½-ton, 6x6, be standardized for issue to the Armored Force after modifications as indicated above have been made."<sup>87</sup>

#### I. Project Termination.

Evidently believing that it had successfully developed the truck desired, the Medical Department Equipment Laboratory--

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even prior to the tests conducted by the Armored Force--took the final step that would normally have ended the project: It sent to The Surgeon General's Office, on 8 August 1942, drawings and specifications of the truck.<sup>88</sup> And four days later, in a letter transmitting its Monthly Narrative Report, the Equipment Laboratory requested that Project F-15.03 be dropped inasmuch as it had been completed.<sup>89</sup> Although the request was repeated in the next narrative report, The Surgeon General's Office withheld concurrence until the Third, Fourth, Fifth, and Sixth Armored Divisions had service-tested the vehicles for several months.<sup>90</sup> Then, on 14 January 1943--just a few days more than a year after the project was officially begun--The Surgeon General's Office formally authorized termination of Development Project F-15.03.<sup>91</sup>

#### J. Delivery of Trucks.

As late as 9 August 1942 the Medical Department Equipment Laboratory had "anticipated that delivery of the 24 surgical trucks by the Krieger Steel Sections, Inc., . . . will be made by August 15, 1942";<sup>92</sup> but a delay in the delivery of cabinets being supplied the manufacturer by another firm<sup>93</sup> made this estimate somewhat over-optimistic. Meantime, after close coordination with the Armored Force concerning its desires relative to disposition of the completed trucks,<sup>94</sup> The Surgeon General allowed certain armored divisions priority<sup>95</sup> and issued the necessary shipping authorizations and instructions.<sup>96</sup>

Subsequent inspection, acceptance, and shipment by rail of the completed units from the factory on or before the dates scheduled occurred as follows:

Six (6) to Third Armored Division, Rico, California, on 1 September 1942;<sup>97</sup>

Six (6) to Fifth Armored Division, Freda, California, on 8 September 1942;<sup>98</sup> and

Six (6) to Sixth Armored Division, Boyce, Louisiana, on 15 September 1942--three days ahead of schedule.<sup>99</sup>

Six (6) vehicles, driven by military personnel, <sup>1</sup> were delivered to the Fourth Armored Division, Pine Camp, New York, on 23 September 1942.<sup>2</sup> From these facts it will be observed that in contravention of the purpose of standardization as expressed in AR 850-25, to be discussed directly, substantial procurement--even delivery--of the surgical truck was consummated prior to standardization of the newly developed vehicle.

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#### IV. Standardization Phase.

##### A. Delay in Initiating Standardization.

"The importance of avoiding delay in the process of standardization of items of equipment," according to the edition of AR 850-25 under which research and development programs were then conducted, "should be realized by all concerned. The classification of an item as standard enables the basis of issue to be determined and procurement planning for necessary production . . . to be inaugurated."<sup>3</sup> Nevertheless, the procedure here implied to be virtually obligatory was conveniently ignored in the interest of prompt quantity procurement.

It is not to be assumed, however, that those responsible for the development of the surgical truck were unaware of the importance attached to early standardization. Headquarters, Services of Supply, had no doubt realized its importance when it directed the appointment of a liaison officer to expedite the standardization of this vehicle.<sup>4</sup> The Surgeon General's Office also was cognizant of it when it informed the Armored Force that "standardization and all action will have to be completed by August 1st, so that we can go into quantity production by that time."<sup>5</sup> And the Director of the Medical Department Equipment Laboratory knew it when he, likewise writing to the Armored Force, remarked that "our directive is to test this pilot model of the surgical truck and get same standardized and ready for procurement by August 1, 1942."<sup>6</sup>

Despite this evidence of a general realization that standardization legitimately precedes procurement, authority to standardize the surgical truck was not forthcoming until a month after the favorable report of the Armored Force had been submitted. And so on 25 September 1942 Headquarters, Services of Supply, directed The Surgeon General "to standardize the Truck, Surgical, 2½-Ton, 6x6, for issue to the Armored Force after modifications have been made as indicated in Armored Force Board Report on Project No. 291, dated August 26, 1942."<sup>7</sup> Although this directive was issued two days after the last lot of six from the original order for 24 surgical trucks had been delivered to the Armored Force, the delay is not considered blameworthy; for, it will be recalled, the Surgeon of the Armored Force had indicated his understanding that whatever changes might be deemed desirable by the Armored Force Board after it had tested the pilot model would in no way affect procurement of the 24 trucks then under contract.<sup>8</sup>

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Just as standardization is a desirable though not always a necessary prerequisite to procurement, the process is also a proper but not always an indispensable step in determining the basis of issue for a new piece of equipment. Thus we find that as early as 1 March 1942 the Table of Organization appropriate to the Company, Armored Medical Battalion--through revision that evidently anticipated successful development of a surgical truck--had authorized for this medical unit two trucks,  $2\frac{1}{2}$ -ton, with "operating room body": one for use in the operating room section, the other for use in the casualty treatment section.<sup>9</sup> It was on the authority of this Table of Organization that the 24 trucks procured prior to standardization of the item were distributed to the Third, Fourth, Fifth, and Sixth Armored Divisions.

B. Process of Standardization.

Development of the vehicle having been completed, The Surgeon General's Office at once turned its attention to standardization of the truck--the record of which action reflects no deviation from the procedure required. Thus by the time the directive of Headquarters, Services of Supply, had arrived, standardization proceedings were well under way.

First, the Subcommittee on Field Equipment of the Medical Department Technical Committee met on 16 September 1942 and recommended

- a. That the Ordnance Department be charged with procurement of the standard  $2\frac{1}{2}$ -ton truck, 6x6, long wheelbase chassis.
- b. That the Medical Department be charged with the procurement of the special type body to be installed on this chassis.
- c. That the Medical Department be further charged with storage and issue of the complete Surgical Truck.
- d. That the Surgical Truck for the Armored Force be standardized and classified as:

Required type
Adopted type
Standard article
- e. That the basis of issue for this item be:  
2 per Medical Company, Armored Medical Battalion.<sup>10</sup>

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The report of the Subcommittee further indicated that, if the proposed basis of issue were approved, 84 trucks costing a total of \$344,400 would be required; that funds were not available; and that 24 units costing \$94,400 had already been procured.<sup>11</sup> These recommendations were approved by the Medical Department Technical Committee on 5 October 1942 and were forwarded two days later to Headquarters, Services of Supply, for its concurrence.<sup>12</sup>

After the Procurement Assignment Board, Headquarters, Services of Supply, on 21 October 1942, had assigned procurement responsibility for the complete item to the Medical Department and purchase responsibility to the Ordnance Department,<sup>13</sup> the Requirements Division, Services of Supply, classified the Truck, 2½-ton, 6x6, Surgical as standard; charged the Medical Department with storage and issue; approved the proposed basis of issue as two per Medical Company, Armored Medical Battalion; and established monthly maintenance figures of 1.7 per cent for the Zone of the Interior and 4.2 per cent for Theaters of Operations.<sup>14</sup> Thus the process of standardization was formally completed on 28 October 1942.

#### C. Proposed Post-Standardization Changes.

Following standardization, however, a number of significant modifications were proposed--one nominal, the others structural. Chronologically, the proposals materially to change the surgical truck came first. Some of these proposals resulted in change; others did not.

In correspondence that was protracted over a period of four months, the first such suggestion--to omit the ladder from the body of the surgical truck--finally was adopted. On 31 October 1942, just a few days after the truck had been standardized, the Armored Force recommended elimination of "the steel ladder protruding from the right front corner of the vehicle" inasmuch as the position of the ladder, which "was not included on the vehicle when the surgical tents were designed and adopted as standard," makes it "apt to interfere with the tight closing of the surgical tent which has been already manufactured and delivered."<sup>15</sup> The need for the ladder was not apparent to the Armored Force, "as the surgical truck tent may be adjusted and the fuel tank of the hot water heater refilled by personnel mounting to the top of the cab from the hood of the truck."<sup>16</sup>

In a subsequent indorsement Headquarters, Services of Supply, "desired that the steel ladder . . . be . . . eliminated entirely unless it can be relocated in such a manner as not to interfere with the tight closing of the surgical tent."<sup>17</sup> The Surgeon General's Office concurred

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and recommended to the Ordnance Department "that steps be taken to change Drawing F-358, showing removal of the ladder," but explained that when the vehicle was standardized a representative of the Ordnance Department had "noted on the record that he did not wish any changes of design or specifications to be made on the truck."<sup>18</sup> On 3 February 1943, the Ordnance Department replied that "contract requirement DED-146 prepared to cover the procurement of 203 surgical trucks requisitioned for the Medical Corps includes the provision that the steel ladder located on the right front corner of the body shall be omitted" and indicated further that the Equipment Laboratory had been requested "to delete from their drawing F-358 the ladder in question."<sup>19</sup>

A recommendation by The Surgeon General's Office that the Medical Department Equipment Laboratory make the necessary changes in its drawings was complied with on 1 March 1943. Unless one is to suppose that once the most immediate requirements of the Armored Force had been satisfied there was no longer great need for haste--an assumption that seems entirely unwarranted in view of the statement by The Surgeon General's Office on 23 February 1943 that "48 trucks are urgently needed by the Armored Divisions named in the attached requisition"<sup>20</sup>--it is difficult to understand why such an apparently simple decision should have required four months to make.

Suggestion for a second change came to The Surgeon General's Office in a telephone conversation with a representative of the Developments Section, Headquarters, Services of Supply, who in an obvious desire to conserve shipping space "requested that steps be taken to provide that the Truck, 2½-ton, 6x6, Surgical be made so that it can be of the knock-down type."<sup>21</sup>

Consequently, The Surgeon General's Office, on 22 March 1943, asked the Armored Force to make studies to determine whether a knock-down surgical truck were practicable and "requested that the following cubatures be furnished:

- a. Vehicle complete.
- b. Vehicle with chassis and body packed separately.
- c. Vehicle with body knock-down and contents packed separately";

but at the same time it informed the Armored Force that "This Office does not feel that it is practical to knock-down the body of this vehicle due to the installation of permanent

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equipment contained therein and has so informed the Headquarters, Services of Supply."<sup>22</sup>

Without actually furnishing the cubatures requested, the President of the Armored Force Board replied that his board "does not believe that any overall advantage would result from converting the Truck, 2 $\frac{1}{2}$ -ton, surgical to a knock-down type" and offered the following arguments in support of this conviction:

a. It is doubtful whether a knock-down type of truck would result in any saving of shipping space when it is considered that the following accessory equipment which could logically be shipped inside the truck would have to be packed separately if the body of the truck were knocked down.

- (1) Water storage tank.
- (2) Hot water heater and tank.
- (3) Fuel tank for heater.
- (4) Sink.
- (5) Cabinets and drawers.
- (6) Miscellaneous equipment such as surgical dressings and instruments.
- (7) Surgical truck tent.
- (8) Ventilating fan.
- (9) Plumbing and electrical fixtures.
- (10) Operating table.
- (11) Electric generator.

b. A considerable amount of equipment and fixtures is built into the body of the surgical truck.

c. Additional time and effort would be required to develop and test a body of the knock-down type.

d. Only six (6) surgical trucks are required per armored division.

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e. It is probable that considerable difficulty would be encountered in setting up a knock-down body and installing its equipment in the field.

f. It appears probable that a knock-down type truck body would be more expensive and less satisfactory in general than the present standardized surgical truck. <sup>23</sup>

As a consequence, the Armored Force Board "recommended that no further consideration be given the development of the Truck, 2½-ton, surgical of the knock-down type." <sup>24</sup>

The indorsement which followed indicated the concurrence of Headquarters, Armored Force, with the Armored Force Board and then continued:

2. In addition to reasons given in above indorsement for the undesirability of a knock-down type of surgical truck, the following are given:

a. The permanent fixtures and installations now on the present standardized surgical truck are definitely needed and would have to be provided for a knock-down type of surgical truck. These would make numerous items to store, to ship, to install when putting the truck together, to get lost, and make the whole matter complicated.

b. A great deal of time would be taken to put the knock-down truck together, thus making it necessary to use the same truck chassis all the time once the knock-down body was installed. This fact nullifies the possible advantage of being able to use any 6x6, 2½-ton, truck chassis in a reasonable time for conversion into a surgical truck and vice versa, using the surgical truck for other purposes.

3. It is recommended that no further consideration be given to the development of the truck, 2½-ton, surgical, of the knock-down type. <sup>25</sup>

Although this communication adds very little to what had already been better expressed in the preceding, more articulate indorsement, it probably did fulfill the purpose for which it was doubtless intended: namely, to emphasize the fact that Headquarters, Armored Force, wanted a knock-down type of truck no more than the Armored Force Board.

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Using these third and fourth indorsements as references, The Surgeon General's Office then recommended to Headquarters, Army Service Forces, "that no further consideration be given to the development of the 2½-ton Truck, 6x6, Surgical of the knock-down type, for reasons stated in indorsements referred to above,"<sup>26</sup> and Headquarters, Army Service Forces, on 27 April 1943 approved this disposition of its original proposal.<sup>27</sup>

The proposal of the third structural change subsequent to standardization of the surgical truck could have been rendered unnecessary by the exercise of foresight. Fortunately, the modifications found needful could be effected so simply that little time or money was lost through making them.

The changes deemed desirable had been discussed at a conference on 3 April 1943 between representatives of the Ordnance Department and the Medical Department Equipment Laboratory. Three days later the Equipment Laboratory informed The Surgeon General's Office of the nature of the problem and of the decision reached to resolve it.

"Since the width of the cab of the open cab type truck" such as that being received by Krieger Steel Sections, Incorporated, "is wider than the cab of the closed cab type 2½-ton, 6x6 truck heretofore utilized for this type of vehicle," the conferees had decided that "both the Evans heater and the hot water heater [should] be moved away from the cab a sufficient distance to permit proper operation of both"--a recommendation which, if followed, would require "a small alteration of the Evans heater and the shell for the water heater."<sup>28</sup> The report further indicated that no change was desired at that time in the five-gallon gasoline tank which supplied fuel for the Evans unit; but it was recommended that "the Evans heater and the water heater of surgical trucks now under procurement be relocated a great enough distance away from the cab to insure proper functioning."<sup>29</sup>

One who has followed carefully the historical details of the development of the surgical truck wonders why the necessity of solving this problem should ever have occurred. Let us hurriedly re-read the story to see why a difficulty of this sort might have arisen.

Early in March of 1942, The Surgeon General's Office had forwarded to the Armored Force for comment and recommendations copies of the Equipment Laboratory specifications for the proposed surgical truck. That was more than a year

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before the conference called to consider relocation of the Evans and of the hot water heater; that was while Development Project F 15.03 still was in its preliminary planning phase; that was months before the pilot model was completed and delivered to the Medical Department Equipment Laboratory; that was even three months before the arrangement was made whereby Chemical Warfare Service agreed to release 24 chassis from its July allocation for conversion into the surgical truck. Even at that early date the Armored Force, objecting that the Equipment Laboratory specification called for a closed cab, explained that "It is understood by this headquarters that future procurement of trucks, 2½-ton, is to be with open cab."<sup>30</sup>

The obvious answer to this objection by the using agency--a very simple one to effect--would seem to have been an unequivocal revision of the specification challenged. The Director of the Equipment Laboratory, nevertheless, rejected the proposed modification: "It is not considered necessary to revise the drawings and specifications to provide for an open cab," he wrote, for "This matter will be taken up by the Equipment Laboratory direct with the Holabird Quartermaster Depot at the time the pilot model is procured. Naturally, if only open cab model trucks are being procured for the Armored Force the Quartermaster will procure this model."<sup>31</sup> Had the Laboratory revised its specifications as the Armored Force initially proposed, however, the difficulty that now arose doubtless would have been foreseen and obviated.

Though not in the form of an actual proposal, a fourth suggestion that other structural changes in the surgical truck were desirable came from the Surgeon of the Armored Force. In June, 1943, The Surgeon General's Office anticipated initiation of a project to develop a surgical operating truck for the Auxilliary Surgical Groups, based on the Truck, 2½-Ton, 6x6, Surgical, previously standardized for use by the Armored Force.<sup>32</sup> Consequently it directed the Medical Department Equipment Laboratory to conduct experiments to test the feasibility of making certain changes in the surgical truck.<sup>33</sup>

Upon receipt of The Surgeon General's letter, the Director of the Equipment Laboratory informally sent an information copy of the directive to the Surgeon of the Armored Force, who gratefully acknowledged its receipt and indicated that he had "a good many ideas concerning certain changes or improvisations for this truck which would improve its functioning" and which he hoped shortly to be able to discuss with the Director of the Equipment Laboratory.<sup>34</sup> He thought that consideration should be given, for example, to the overloading of the truck when personnel was aboard; a "suitable arrangement . . . to lead off water from the

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sink"; "a ramp to permit the wheeling of cases into the body of the truck"; and a number of other changes involving surgical equipment, the Quartermaster tent, and so forth<sup>35</sup>--changes not directly related to the structure of the truck itself. Since these ideas never became more than informal suggestions, however, they are mentioned only for whatever of value they may be to the future student of Development Project F-15.03, Truck, 2 $\frac{1}{2}$ -Ton, 6x6, Surgical.

We have seen that from the moment the surgical truck project was initiated the Medical Department had realized the importance of having one body that could easily be adapted to the purposes of virtually every type of mobile medical unit. This basic body, this important component of the surgical truck, was itself to be standardized as a separate Medical Department item. It is not surprising, then, that the last post-standardization change in the construction of the surgical truck should have come not from the necessity of modifying the vehicle as such, but from the need of making its body conform to characteristics of the multi-purpose van as developed for other mobile units utilizing as their basic body the Truck, Van, Medical, 2 $\frac{1}{2}$ -Ton, 6x6 (4dt) soon to be standardized.

Consequently, on 18 April 1944, The Surgeon General's Office explained to the Surgeon, Army Ground Forces, what modifications would be involved when the multi-purpose van body was used in fabricating the surgical trucks, and it requested his concurrence or alternate suggestions. The structural alterations that the Surgeon of the Ground Forces was thus presented with were substantially as follows:

1. Sink located nearer center of front of body.

2. Number of windows increased from two to four, with changes in cupboards and drawers necessitated in providing space for two new windows.

3. Provision for certain cabinets to be of same height so as to provide a continuous top surface about 36" high--a change which required elimination of three deep drawers in each drawer unit.<sup>36</sup>

The Surgeon of the Army Ground Forces reported that he had no objection to incorporating these modifications of body design into the surgical truck and thus concurred, on 22 April 1944, in the use of the multi-purpose van body in the manufacture of surgical trucks for the Armored Force.<sup>37</sup>

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The final change in the item following standardization was not structural but merely nominal. In formally approving classification of the vehicle, Headquarters, Services of Supply, had indicated that its nomenclature would be Truck, 2½-Ton, 6x6, Surgical.<sup>38</sup> This nomenclature must have become garbled during the next 18 months, however, for on 29 April 1944 the Catalog Branch of The Surgeon General's Office recommended "that action be taken to effect change in nomenclature of subject item "Item 99590 Truck, Surgical to 'Truck, 2½-Ton, 6x6, Surgical, ' in order that nomenclature for this vehicle may be in conformity with the surgical and dental trucks recently standardized."<sup>39</sup>

After this suggestion had been properly processed through the Subcommittee of the Medical Department Technical Committee, Headquarters, Army Service Forces, gave its approval of the change;<sup>40</sup> the Supply Service, Surgeon General's Office, was appropriately informed;<sup>41</sup> and the approved nomenclature was read for record before the Medical Department Technical Committee.<sup>42</sup> Thus was accomplished the last change authorized for the surgical truck.

#### V. Procurement Phase.

The zeal and industry which had characterized the activity of both military and civilian agencies during the earlier phases of rapid development and emergency procurement of the surgical truck carried through unabated--except for the delay in processing the proposal to delete the ladder--into the later phase of mass procurement.

Even before fabrication and delivery of the 24 surgical trucks on emergency order had been completed, for example, The Commanding General of the Armored Force--on 11 September 1942--requested that The Surgeon General take necessary action "for the procurement of the surgical trucks and black-out tents for all medical units of the Armored Force on the same basis of issue as heretofore established for the armored medical battalions of the first six armored divisions."<sup>43</sup> Consequently, on 6 January 1943 the Office of The Surgeon General prepared a requisition for 203 trucks at a "total estimate" of \$625,225, or at an indicated unit cost of \$3,075, a figure later proved to be underestimated by nearly \$1100. The Ordnance Department was instructed to "SHIP AS SOON AS STOCK IS AVAILABLE" the first 48 surgical trucks, six units each to the Seventh through Fourteenth Armored Divisions then stationed as indicated within the Zone of the Interior; further information concerning "Distribution for the remaining 155 surgical trucks," it was promised, "will be furnished upon notification of Office of Surgeon General, Purchases Division, by Ordnance Department that an additional number

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of trucks is available."<sup>44</sup>

Two months after the requisition had been drafted The Surgeon General requested Ordnance to furnish him with the "distribution dates for first 48 trucks" requisitioned,<sup>45</sup> to which the Ordnance Department replied that the "present shipping schedule for the movement of the Chassis to the Kreiger [sic] Steel Sections, Inc. is as follows:

Week of March 8, 1943	-	40
March 15, 1943	-	23
March 22, 1943	-	20
March 29, 1943	-	20
April 5, 1943	-	20
April 12, 1943	-	20
April 19, 1943	-	20
April 26, 1943	-	20
May 3, 1943	-	20
		<u>203</u>

TOTAL (Chassis)"<sup>46</sup>

The projected dates on which "the completed Trucks, 2½-Ton, 6x6, with Surgical Bodies will become available at the Kreiger [sic] Steel Sections, Inc., Long Island, New York," was also indicated:

"Week of March 21, 1943	-	5
March 28, 1943	-	5
April 4, 1943	-	15
April 11, 1943	-	15
April 18, 1943	-	20
April 25, 1943	-	20
May 2, 1943	-	20
May 9, 1943	-	20
May 16, 1943	-	20
May 23, 1943	-	20
May 30, 1943	-	20
June 7, 1943	-	23
		<u>203</u>

TOTAL"<sup>47</sup>

It is beyond the scope of this essay on research and development of the surgical truck to examine the reasons for the lack of coordination during the mass procurement phase which resulted in at least a momentary over-production of the surgical truck. Suffice it to record that within less than a week after The Surgeon General's Office had been furnished the delivery schedules just quoted, it decided that it would be "necessary to store some of these trucks in available depots."<sup>48</sup> Although it was explained that a number of these vehicles "will be required as replacements for trucks which are destroyed in or captured in combat,"<sup>49</sup> it apparently was becoming clear that if the delivery schedule were met the Medical Department would have many more surgical trucks than

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it had any immediate need for. In any event, after coordination had been effected both within The Surgeon General's Office and with the Armored Force itself, a memorandum announced that arrangements had been made to have "outside storage space" assigned at the Montgomery Holding and Reconsignment Point, Montgomery, Alabama, for trucks that were temporarily surplus and that a representative of the Ordnance Department had been advised "to ship vehicles he does not receive other distribution on" to that installation.<sup>50</sup>

Surely there was now no urgent need for more surgical trucks--not so long as there existed conditions like that hinted at in the following telegram which came to the Commanding General, Army Service Forces, from the Headquarters of the Ninth Service Command:

. . . . REPORT THAT CG DESERT TRNG CTR HAS TURNED IN TO SERV COMD MOTOR POOL SIX TRUCKS TWO AND ONE HALF TON SIX BY SIX WITH ELABORATE SURG INSTLS STOP THESE WERE TURNED IN BY DEPARTING UNITS STOP REQUEST INFO TO WHAT UNITS THESE SHOULD BE REISSUED OR WHAT OTHER DISP SHOULD BE MADE OF THIS SPECIAL MOTOR EQUIP END. . . .<sup>51</sup>

An exchange of telegrams having revealed that these vehicles were standard trucks, 2 $\frac{1}{2}$ -ton, 6x6, surgical and not semi-trailer units and that they had been turned in by the Ordnance Officer of the Seventh Armored Division, the telegrams were transmitted to the Surgeon of the Army Ground Forces as a question for his office to answer.<sup>52</sup>

With some trucks being assigned storage space at a holding and reconsignment point and with others being turned in at motor pools by armored divisions to which they had been issued as organizational equipment, it is apparent that the urgency once so provocative of anxiety to those needing the surgical trucks had ceased to exist. If still further proof of this trend in supply were demanded, one could point to the facts that planners of procurement in October 1943 were considering diverting 19 of the surgical trucks to the Medical Department Equipment Laboratory for conversion into mobile dental units;<sup>53</sup> that by the last of November 1943 some 91 surgical truck bodies had been completed far ahead of schedule and were being held at the Krieger Steel Section, Incorporated, plant awaiting delivery of chassis on which to mount them;<sup>54</sup> and that the only apparent objection to an Ordnance proposal that a number of chassis sufficient to move these 91 bodies could be diverted from other Ordnance contracts lay in the inability of the Medical Department to show that it had any immediate need for these 91 plant-locked units.<sup>55</sup>

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The Medical Department, then, might justifiably be charged with inadequate planning, inaccurate computation of requirements, and, in this instance, of insufficient coordination--particularly when one realizes that Theaters of Operations were authorized only 72 of the vehicles in 1944 and only 90 in 1945,<sup>56</sup> whereas a contract had been let for 203 units in addition to the 24 originally ordered. And, conversely, any contention that the Medical Department was unable to supply all the surgical trucks that were immediately required would certainly be untenable. The Medical Department had, in fine, progressed far in development and procurement from that time when, less than 18 months before, the Surgeon of the Armored Force, unassured that he could depend on securing the trucks through regular channels, had requested funds from The Surgeon General for the local construction of 24 trucks so urgently needed by the armored divisions.

## VI. Evaluation.

No appraisal of Project F 15.03--Truck, 2½-Ton, 6x6, Surgical--can be considered just if it neglects to accord abundant consideration to three general features of the developmental program that served, either individually or in combination, to impede its smoothest and most efficient operation: namely, (1) the necessity, relieved only by the rough improvisation of the First Armored Division, of "starting from scratch"; (2) the difficulty of securing, until late in the course of the project, adequate funds for the development; and (3) the continuous demand for rapid development and speedy procurement dictated by the urgent requirements of the Armored Force. Although such a generalization can not be defended as being applicable without exception, it might be strongly argued that the inadequacies in the surgical truck which did exist and many of the faults that were manifested in the administration of its formal development resulted from the pressure created by one or more of these three difficult conditions which may be observed in the discussion below.

### A. The Item.

A significant indorsement of the surgical truck itself, it would seem, appears not so eloquently in what was said in commendation of it as in what was left unsaid--and undone. The fact that the changes, suggested as desirable by the Surgeon of the Armored Force, were never formally proposed tends to indicate that the surgical truck, though admittedly subject to refinements, was nevertheless considered quite adequate for the needs of the Armored Force, the sole user of the vehicle as such.

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The importance of the Truck, 2½-Ton, 6x6, Surgical--the ultimate refinement of that crude improvisation of the First Armored Division--cannot be minimized as a means of providing adequate medical support for units of the fast-moving Armored Force. Nevertheless, when the historian takes a comprehensive view of the complete program of research and development of medical field equipment, following the first ominous rumblings of World War II, he must observe also that the concurrent and correlative development of the body of the surgical truck as a multi-purpose carrier was even more important. Obviously, the successful development of the all-purpose van body would materially reduce the expenditure of time, labor, materials, and money required for subsequent development of mobile units, which might utilize substantially the same carrier. The adoption of a standard van body to be used in practically all mobile units of the Medical Department, furthermore, would greatly facilitate the production and procurement of the vehicles, purchase responsibility for which had been assigned to the Ordnance Department. And finally--though this advantage did not become apparent until later, when difficulty developed in the procurement of carriers for the Mobile Dental Laboratory and other units, to be discussed in subsequent chapters--some of the surgical trucks then on hand but not immediately needed could, with a minimum expenditure of time and effort, be converted into carriers for other types of mobile units. Thus the decision to develop an all-purpose body for the surgical truck was indeed a sound one--so sound, in fact, that it led ultimately to standardization of the body as such.

#### B. Administration of Project.

Although results achieved so promptly from Development Project F 15.03 are actually little short of remarkable, a fact which tends to allay severe criticism of any maladministration of the project, there are strictures of several apparently inexcusable improprieties in the administration of the program that should be made if such evils are to be avoided in similar future projects.

##### 1. Procedural Aspects.

In the first place, The Surgeon General's Office deviated from the procedural requirements of AR 850-25 in initiating its request for formal approval of the project. An attempt to judge whether this "short cut" was inadvertent or whether it was a deliberate effort to expedite the project would become only fruitless speculation. Whatever the motive for the action, reprocessing the request through the Medical Department Technical Committee in conformity with the

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provisions of AR 850-25 resulted in the loss of four weeks of valuable time.

A second departure from customary procedure--though not in direct contravention of the provisions of AR 850-25--occurred early in the phase of project initiation, when G-4 Division of the War Department General Staff assumed the role of coordinator with the Armored Force. Though G-4 had a legal and command prerogative to appropriate this function, since Army Regulations then in force specifically charged the War Department General Staff with responsibility for supervising the preparation of research and development programs, the same regulations also charged the appropriate technical committee--in this instance, the Medical Department Technical Committee--with the actual preliminary coordination of the projects among all interested agencies.<sup>57</sup> It is difficult to understand, then, (1) why coordination with the Armored Force had not been completely effected by the Medical Department Technical Committee before it requested G-4 to approve initiation of the project; and (2) why, unless in the interest of expediting the project, G-4 did not again refer the program to the Medical Department Technical Committee instead of effecting the necessary coordination with the Armored Force which the technical committee had seemingly failed to perform.

But very little time, if any, was lost because of the singularity of this procedure; and since the records apparently do not sufficiently explain this unusual action, it is mentioned not in criticism either of the Medical Department Technical Committee or of the War Department General Staff, but merely as a noteworthy and apparently unnecessary departure from routine procedure as established by AR 850-25.

Negotiating for procurement at a time when standardization (or, for that matter, even development) had not been accomplished was a third deviating procedural step taken by the administrators of Development Project F 15.03. In this instance, nevertheless, the officers of the Medical Department deserve not censure, but praise; for if the letter of intent to purchase 24 of the surgical trucks had not been proffered--an action that was concurred in by Headquarters, Services of Supply--it is disturbing to contemplate the further loss of time that might have occurred during the development and procurement of the immediately-to-be-needed surgical truck and the resultant delay in its subsequent issue to combat units.

## 2. Engineering and Procurement.

So far, this evaluation of the administration of the project has been restricted to its procedural aspects.

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We now conclude by briefly reviewing the administration of what might be termed the development (or engineering) and procurement aspects of the program.

The Surgeon General had expressly desired, one will recall, preparation of "paper plans" for the development of the surgical truck, pending authorization of funds that would allow formal initiation of the project. Although these "paper plans" apparently were never prepared, initial planning, once instigated, was generally excellent, as witness the foresight manifested in the concurrent development of the multi-purpose van body.

Furthermore, when later development was momentarily stalemated because of the Quartermaster's delay in completing his part of the preliminary planning, the unhappy situation was happily remedied by the intervention of Headquarters, Services of Supply, which directed almost immediately that the Quartermaster Department complete the specifications and promptly construct the pilot model. To preclude any further delay Headquarters, Services of Supply, again directed--this time at the instigation of The Surgeon General's Office--that a liaison officer be appointed specifically for the project. From that point forward there was no really serious retardment either in development or in production; and the foresight manifested in formally designating a liaison officer to expedite the project, when coupled with the whole-hearted efforts and cooperation of the small Krieger company, undoubtedly accounts in very large measure for the delivery of the pilot model to the Medical Department Equipment Laboratory for testing only eight days behind a time-starved schedule. This achievement becomes all the more impressive when one recalls that the difficulty of securing a contractor did not arise until after the deadline date for completion of the pilot model.

Less expeditiously resolved, however, were other difficulties that are basically indicative of faulty administration--difficulties that were, fundamentally, a result of a seemingly unsympathetic appraisal by the Director of the Medical Department Equipment Laboratory of virtually all suggestions relative to engineering development that came from a source outside his own organization. Many of the features of the surgical truck desired by the Armored Force which were at first summarily ill-regarded by the Equipment Laboratory were later accepted--seldom with much loss of time, yet frequently over protests registered by the Director of the Laboratory. Since this unsympathetic attitude of the Medical Department Equipment Laboratory is manifested not only here but occasionally in other similar projects, one wonders why The Surgeon General's Office did



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not at this time inaugurate a policy of more active and more positive direction of the entire program of Medical Department research and development.

Just one observation need be made about procurement. Whereas the Subcommittee of the Medical Department Technical Committee had reported that 84 surgical trucks would be required and that 24 had already been procured, contracts for 203 of the units were subsequently let. The apparent overproduction that finally resulted is a matter of concern to the historian of the Supply Service rather than of research and development; but since the surgical truck could with fair ease be converted into other mobile units of the Medical Department later to be developed, the surplus of surgical trucks was actually a boon not only in the research and development program, but also in the procurement program of mobile units other than the surgical.

Whatever the deficiencies to be observed in the prosecution of Development Project F 15.03, the real value of the undertaking lay in its power to deliver the desired goods, and to deliver them on time. Since the Truck, 2 $\frac{1}{2}$ -Ton, 6x6, Surgical, had not only been developed and standardized, but was also being delivered in substantial number to combat units within 12 $\frac{1}{2}$  months of formal initiation of the project, one must conclude that considerable progress was made in achieving The Surgeon General's objective, as stated on 20 August 1941, to develop at the earliest possible date effective medical support for armored and other fast-moving units.

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FOOTNOTES TO CHAPTER V

<sup>1</sup>Table of Organization 8-78, Medical Company, Clearing Battalion, Armored Division, 15 Nov. 1940.

<sup>2</sup>Ibid.

<sup>3</sup>Medical Department, U.S. Army: Research and Development Program, Fiscal Year 1942, 20 Aug. 1941, CONFIDENTIAL, p. 1 (Hist. Div., S.G.O.). Extracted in clear.

<sup>4</sup>Ibid., p. 52.

<sup>5</sup>Ibid.

<sup>6</sup>Ltr. to T.S.G., fr. Research Coordination Br., Plans Div., S.G.O., 12 Oct. 1943; subject: "Monthly Status Report on Research and Development Projects for the Month of September 1943," SECRET (Hist. Div., S.G.O.). Extracted in clear.

<sup>7</sup>Ltr. to T.A.G., fr. Exec. Office, S.G.O., 16 Oct. 1941; subject: "Research Project--Surgical Truck for Clearing Company, Armored Force"; et passim (A.M.R. & D. Bd.).

Just what the "current available funds" consisted of is not explained. Obviously the \$6,000 originally requested was not considered sufficient to complete the development, for even as late as April, 1942, the Medical Department Equipment Laboratory reported that it would need for the development of Projects F 15.01, 15.02, and 15.03 (all components of the general project titled "Combat Medical Service for the Armored Force") a total during Fiscal Year 1943 of \$68,400:--\$3,600 for civilian personnel and \$64,800 for supplies and materials. (Monthly Progress Report, M.D.E.L., Apr., 1942, p. 16--A.M.R. & D. Bd.)

<sup>8</sup>Ltr. to T.A.G., fr. Exec. Office, S.G.O., 16 Oct. 1941; subject: "Research Project--Surgical Truck for Clearing Company, Armored Force"; et passim (A.M.R. & D. Bd.).

<sup>9</sup>Ibid.; et passim. But see discussion of experimental truck developed by 47<sup>th</sup> Medical Battalion (Armored), Ft. Knox, Ky., pp. 300 ff., infra.



- 10 Medical Department, U.S. Army: Research and Development Program, Fiscal Year 1942, 20 Aug. 1941, CONFIDENTIAL, p. 53 (Hist. Div.; S.G.O.): Extracted in clear.
- 11 Memo. to T.S.G., fr. Acting Asst. Chf. of Staff, W.D.G.S., Supply Div., G-4; 27 Oct. 1941; subject: "Reference of Proposed Development Projects to Medical Corps Technical Committee (Mobile Aid Station, Mobile Hospital Wards and Surgical Truck)" (Rec. Rm., S.G.O. 451.2-1).
- 12 Rpt. to M.D.T.C., fr. Subcommittee on Research Project--Surgical Truck for Clearing Company, Armored Force, 4 Nov. 1941; subject: "Research Project--Surgical Truck for Clearing Company, Armored Force" (A.M.R. & D. Bd.). For proposed military characteristics, see p. 298, supra.
- 13 Min. of M.D.T.C., Meeting No. 3, 17 Nov. 1941, p. 3 (Hist. Div., S.G.O. 334.8-1).
- 14 1st Ind. to The Asst. Chf. of Staff, G-4, fr. S.G.O., 18 Nov. 1941; basic: memo. to T.S.G., fr. Acting Asst. Chf. of Staff, W.D.G.S., Supply Div., G-4, 27 Oct. 1941 (Rec. Rm., S.G.O. 451.2-1).
- 15 Memo. to the Chf. of the Armored Force, fr. Armored Force Liaison Officer, Office of the Liaison Officer, Hq., Armored Force, Washington, D.C., 27 Nov. 1941; et passim (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).
- 16 1st Ind. to Liaison Officer, Armored Force, Washington, D.C., fr. Asst. A.G., Hq., Armored Force, Office of the C.G., Ft. Knox, Ky., 11 Dec. 1941; basic: see n. 15, above (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).
- 17 Ibid.
- 18 1st Ind. to T.S.G., fr. T.A.G., 30 Dec. 1941; basic: ltr. to T.A.G., fr. Exec. Office, S.G.O., 16 Oct. 1941; subject: "Research Project--Surgical Truck for Clearing Company, Armored Force" (Rec. Rm., S.G.O. 451.2-1).
- 19 2d Ind. to Dir., M.D.E.L., fr. S.G.O., 1 Jan. 1942; basic: see n. 18, above (Rec. Rm., S.G.O. 451.2-1).
- 20 3rd Ind. to S.G.O., fr. Dir., M.D.E.L., 7 Jan. 1942; basic: see n. 18, above (Rec. Rm., S.G.O. 451.2-1).

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- 21 See Armored Force Board Photos 1414, 1420, 1421, "Surgical truck (Experimental), 47th Medical Bn. (Armd), 7/25/41, Fort Knox, Kentucky" (A.M.R. & D. Bd.)
- 22 Memo. to Finance and Supply Div. [S.G.O.], fr. Asst. to T.S.G., 7 Jan. 1942 (A.M.R. & D. Bd.).
- 23 Ibid.; et passim.
- 24 Ltr. to T.S.G., fr. Hq., Armored Force, Ft. Knox, Ky., 15 Apr. 1942; subject: "Surgical Truck, Treatment Platoon, Medical Company, Armored," Incl. 2 (Rec. Rm., S.G.O. 451.2-1).
- 25 Ltr. to T.S.G., fr. Hq., Armored Force, Ft. Knox, Ky., 18 Jun. 1942; subject: "Allocation of Funds for Construction of Surgical Trucks" (A.M.R. & D. Bd.).
- 26 5th Ind. to Hq., Armored Force, fr. S.G.O., 13 Jul. 1942; basic: see n. 24, above (A.M.R. & D. Bd.). See, also, preceding 1st Ind. to T.S.G., fr. Hq., A.G.F., Thru Hq., S.O.S., 25 Jun. 1942 and 2d Ind. to T.S.G., fr. Hq., S.O.S., 6 Jul. 1942 (A.M.R. & D. Bd.).
- 27 See p. 297, supra.
- 28 Ltr. to M.D.E.L., fr. Hq., 48th Armored Medical Bn., 2d Armored Div., 18 Jan. 1942; subject: "Plans for Surgical Truck Armored Medical Battalion" (M.D.E.L.).
- 29 1st Ind. to 48th Armored Medical Bn., 2d Armored Div., fr. M.D.E.L., 21 Jan. 1942 (M.D.E.L.).
- 30 Ltr. to T.S.G., fr. Hq., Armored Force, Office of the Surgeon, 13 Jan. 1942; subject: "New Items Organic Equipment, Medical Battalion, Armored Division--T/O 'L,' January 1, 1942" (A.M.R. & D. Bd.).
- 31 2d Ind. to T.S.G., fr. M.D.E.L., 26 Jan. 1942; basic: see n. 30, above (A.M.R. & D. Bd.).
- 32 Monthly Progress Report, M.D.E.L., Jan., 1942, p. 17, et passim (A.M.R. & D. Bd.).
- 33 Ibid.

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- 34 Ltr. to T.S.G., fr. Dir., M.D.E.L., 7 Feb. 1942; subject: "Surgical Truck for Clearing Company, Armored Force" (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).

Evidence of the validity of this early but far-sighted reasoning, the conviction that a multipurpose van body could be designed for use with various mobile units of the Medical Department, is found in the formal standardization on 12 Sep. 1944 of the Truck, Van, Medical, 2 $\frac{1}{2}$ -Ton, 6x6 (4 dt). See 2d Ind. to Chf. of Ord., fr. Dir., Research and Development Div., Hq., A.S.F., 12 Sep. 1944; basic: not on file (A.M.R. & D. Bd.).

- 35 Ibid.

- 36 2d Ind. to Hq., Armored Force, Ft. Knox, Ky., fr. S.G.O., 2 Mar. 1942; basic: see n. 34, above (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).

- 37 3rd Ind. to C.G., S.O.S., (Attn: Surgeon Gen.), fr. Hq., Armored Force, Ft. Knox, Ky., 12 Mar. 1942; basic: see n. 34, above (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).

- 38 Ibid.; et passim.

- 39 Ibid.

- 40 5th Ind. to S.G.O., fr. M.D.E.L., 24 Mar. 1942; basic: see n. 34, above (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).

- 41 7th Ind. to T.Q.M.G., fr. S.G.O., 28 Mar. 1942; basic: see n. 34, above (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).

- 42 Monthly Progress Report, M.D.E.L., Apr., 1942, p. 16;  
et passim (A.M.R. & D. Bd.).

- 43 Notes on conference held at Holabird QM Depot, 21 Apr. 1942; subject: "Surgical Truck for Clearing Company" (M.D.E.L.).

The Quartermaster General had not considered favorably "the mounting of the 13 ft. van body on the standard 2 $\frac{1}{2}$ -ton, 6x6 chassis (164" wheelbase)" and had suggested to the Commanding Officer, Holabird Quartermaster Depot, a "bolted-on extension if the over-hang (back of the rear wheels) is considered essential by the Medical Dept." (8th Ind. as synopsized "for record" on 11th Ind. to T.Q.M.G., fr. Hq.,

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S.O.S., 24 Jun. 1942 (A.M.R. & D. Bd.); basic: ltr. to T.S.G., fr. Dir., M.D.E.L., 7 Feb. 1942; subject: "Surgical Truck for Clearing Company, Armored Force" (Rec. Rm., S.G.O. 451.2-1).

44 Ltr. to Hq., Armored Force, Ft. Knox, Ky., fr. S.G.O., 21 May 1942; subject: "Surgical Truck for Armored Force" (A.M.R. & D. Bd.).

45 Ltr. to T.S.G., fr. Hq., Armored Force, Office of the Surgeon, Ft. Knox, Ky., 15 Apr. 1942; subject: "Surgical Truck, Treatment Platoon, Medical Company, Armored," Incl. 2 (Rec. Rm., S.G.O. 451.2-1); and cf. passim.

46 3rd Ind. to T.S.G., fr. Dir., M.D.E.L., 1 May 1942; basic: ltr. to T.S.G., fr. Hq., Armored Force, Office of the Surgeon, Ft. Knox, Ky., 15 Apr. 1942; subject: "Surgical Truck, Treatment Platoon, Medical Company, Armored" (Rec. Rm., S.G.O. 451.2-1).

47 Telegram to T.S.G., fr. Devers, Ft. Knox, Ky., 30 May 1942 (A.M.R. & D. Bd.).

48 Monthly Progress Report, M.D.E.L., 1 May--9 Jun. 1942, p. 13 (A.M.R. & D. Bd.).

49 Ltr. to T.S.G., thru T.C.G., A.G.F., fr. Hq., Armored Force, Ft. Knox, Ky., 18 Jun. 1942; subject: "Allcation of Funds for Construction of Surgical Trucks" (M.D.E.L.).

50 1st Ind. to T.S.G., thru T.C.G., S.O.S., fr. Hq., A.G.F., 25 Jun. 1942; basic: see n. 49, above; et passim (M.D.E.L.).

51 Ibid.; et passim.

52 2d Ind. to T.S.G., fr. Hq., S.O.S., 6 Jul. 1942; basic: see n. 49, above (M.D.E.L.).

53 3rd thru 5th Inds., 7, 10, and 13 Jul. 1942, respectively; basic: see n. 49, above (A.M.R. & D. Bd.).

54 Ltr. to Lt. Col. Neil Page, S.G.O., fr. Hq., Armored Force, Office of the Surgeon, Ft. Knox, Ky., 17 Jun. 1942; et passim (A.M.R. & D. Bd.).

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55 Ltr. to Col. Albert W. Kenner, Hq., Armored Force, Office of the Surgeon, Ft. Knox, Ky., fr. John B. Klopp, Maj., M.C., 24 Jun. 1942 (A.M.R. & D. Bd.).

56 11th Ind. to T.Q.M.G., fr. Hq., S.C.S. [24 Jun. 1942]; basic: ltr. to T.S.G., fr. Dir., M.D.E.L., 7 Feb. 1942; subject: "Surgical Truck for Clearing Company, Armored Force" (A.M.R. & D. Bd.).

57 See n. 55, above (A.M.R. & D. Bd.).

58 Ibid.; et passim.

59 Ibid.

60 Memo. to Dir., M.D.E.L., fr. John B. Klopp, Maj., M.C., 26 Jun. 1942; subject: "Pilot Model for Proposed Surgical Truck" (A.M.R. & D. Bd.).

61 Ltr. to T.Q.M.G., fr. Dir., Requirements Div., Hq., S.C.S., 27 Jun. 1942; subject: "Letter of Intent for Surgical Truck" (A.M.R. & D. Bd.).  
In a note "for record" on this letter it is stated that "This company was selected because of their workmanship and proximity to Carlisle Barracks."

62 Ltr. to T.S.G., fr. Dir., Requirements Div., Hq., S.C.S., 27 Jun. 1942; subject: "Liaison Officer During Construction of Pilot Model Surgical Truck" (A.M.R. & D. Bd.).

63 Ltr. to Col. Albert W. Kenner, Hq., Armored Force, Office of the Surgeon, Ft. Knox, Ky., fr. John B. Klopp, Maj., M.C., 2 Jul. 1942 (A.M.R. & D. Bd.).

64 Ibid.

65 1st Ind. to Development Br., Requirements Div., S.C.S., fr. S.G.O., 4 Jul. 1942; basic: see n. 62, above (A.M.R. & D. Bd.).

66 Memo. to T.Q.M.G., fr. Dir., Requirements Div., S.C.S., 6 Jul. 1942; subject: "Chassis for Armored Force Surgical Vehicles" (Rec. Rm., S.G.O., 451.2-1).



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- 67 Notes on conference with Krieger Steel Sec., Inc., 6 Jul. 1942 (M.D.E.L.).  
For enumeration of decisions reached, see Appendix A.
- 68 Ltr. to Krieger Steel Sec., fr. M.D.E.L., 8 Jul. 1942 (M.D.E.L.).  
For a copy of this letter, see Appendix B.
- 69 Ltr. to Hq., Armored Force, fr. M.D.E.L., 8 Jul. 1942 (M.D.E.L.).
- 70 Monthly Narrative Report, M.D.E.L., 10 Jun. - 9 Jul. 1942, p. 12 (A.M.R. & D. Bd.).
- 71 Monthly Narrative Report, M.D.E.L., 10 Jul. - 9 Aug. 1942, p. 12 (A.M.R. & D. Bd.).
- 72 11th Ind. to T.Q.M.G., fr. Hq., S.O.S., [24 Jun. 1942]; basic: ltr. to T.S.G., fr. Dir., M.D.E.L., 7 Feb. 1942; subject: "Surgical Truck for Clearing Company, Armored Force" (A.M.R. & D. Bd.); quoted and discussed on pp. 311-312, supra.
- 73 Notes on conference held at Carlisle Bks., 21 Jul. 1942; subject: "Changes Surgical Trucks" (M.D.E.L.).  
For detailed notes on changes recommended and concurred in at this conference, see Appendix C.
- 74 Ltr. to Surgeon, Armored Force, fr. M.D.E.L., 22 Jul. 1942 (M.D.E.L.).
- 75 Ibid.
- 76 Ltr. to M.D.E.L., fr. Surgeon, Armored Force, 29 Jul. 1942 (M.D.E.L.).
- 77 Ltr. to Surgeon, Armored Force, fr. Dir., M.D.E.L., 31 Jul. 1942 (M.D.E.L.).
- 78 Ibid.
- 79 Ibid.
- 80 Ibid.



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81 Ltr. to T.S.G., fr. Dir., M.D.E.L., 1 Aug. 1942; subject:  
"Contract W2425-QM-260 (Surgical Truck)" (A.M.R. & D. Bd.).

82 Ltr. to T.C.G., M.F.S.S., fr. S.G.O., 6 Aug. 1942; subject:  
"Surgical Truck" (Rec. Rm., S.G.O. 451.2-1).

83 Ltr. to T.C.G., Carlisle Bks., Pa., fr. S.G.O., 11 Aug.  
1942; subject: "Transfer of Surgical Truck" (Rec. Rm.,  
S.G.O. 451.2-1).

84 Test of Surgical Truck and Tent, Project No. 291, The  
Armored Force Board, Ft. Knox, Ky., 26 Aug. 1942 (Dev. Br.,  
Req. Div., S.O.S. /A.S.F./, S.P. 451.2.)

85 Ibid.; et passim.

86 Ibid. For complete text of the Armored Force Board report,  
see Appendix D.

87 Ibid.

88 Ltr. to S.G.O., fr. M.D.E.L., 8 Aug. 1942; subject:  
"Surgical Trucks" (M.D.E.L.).

89 Ltr. to S.G.O., fr. M.D.E.L., 12 Aug. 1942; subject:  
"Monthly Narrative Report, 10 Jul. - 9 Aug. 1942"  
(Hist. Div., S.G.O.).

90 See comments on Project F-15.03 in Monthly Narrative Report,  
M.D.E.L., covering the period 10 Sep. - 9 Oct. 1942  
(Hist. Div., S.G.O.).

91 Monthly Narrative Report, M.D.E.L., 10 Jan. - 9 Feb. 1943,  
p. 8 (Hist. Div., S.G.O.).

92 Ibid., 10 Jul. - 9 Aug. 1942, p. 12 (A.M.R. & D. Bd.).

93 Memo. to Mr. M.W. Ziegler of Krieger Steel Sec., Inc., fr.  
William R. Cubbins, Jr., Motor Transport Service, 24 Aug.  
1942; subject: "Contract No. W-2425-QM-260, Surgical Units"  
(A.M.R. & D. Bd.).

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94 Memo. to O.Q.M.G., fr. S.G.O., 23 Jul. 1942; subject: "Surgical Trucks, w/1st, 2nd, 3rd & 4th Inds. (A.M.R. & D. Bd.).

95 1st Ind. to Hq., Armored Force, Ft. Knox, Ky., fr. S.G.O., 25 Aug. 1942; basic (not on file): ltr. to T.S.G., fr. Hq., Armored Force, 30 Jul. 1942; subject: "Delivery of Surgical Trucks" (A.M.R. & D. Bd.).

96 Teletype to N.Y. Medical Depot, fr. Hays /Finance and Supply Service, S.G.O., 26 Aug. 1942 (A.M.R. & D. Bd.).

97 Ltr. to T.S.G., fr. M.D.E.L., 8 Sep. 1942; subject: "Contract W-2425-QM-260 (Surgical Truck)" (A.M.R. & D. Bd.).

98 Ltr. to T.S.G., fr. M.D.E.L., 14 Sep. 1942; subject: "Contract W-2425-QM-260 (Surgical Truck)" (A.M.R. & D. Bd.).

99 Ltr. to Maj. Christie, Carlisle Bks., Pa., fr. Krieger Steel Sec., Inc., 16 Sep. 1942; and ltr. to T.S.G., fr. M.D.E.L., 18 Sep. 1942; subject: "Contract W-2425-QM-260 (Surgical Truck)" (A.M.R. & D. Bd.).

1 Memo. to Personnel Div., fr. Planning Div., S.G.O., 27 Aug. 1942 (A.M.R. & D. Bd.).

2 Ltr. to T.S.G., fr. M.D.E.L., 20 Nov. 1945; subject: "History, Surgical Truck for Clearing Company," Incl. 1, p. 20 (Hist. Div., S.G.O.).

3 AR 850-25, 23 Jul. 1936.

4 Supra, p. 313.

5 Ltr. to Col. Albert W. Kenner, Hq., Armored Force, Office of the Surgeon, Ft. Knox, Ky., fr. John B. Klopp, Maj., M.C., 24 Jun. 1942 (A.M.R. & D. Bd.).

6 Ltr. to Hq., Armored Force, fr. M.D.E.L., 8 Jul. 1942 (M.D.E.L.).

7 2d Ind. to S.G.O., fr. Hq., S.O.S., 25 Sep. 1942; basic: ltr. to C.G., A.G.F., fr. Hq., Armored Force, 8 Sep. 1942 (A.M.R. & D. Bd.).

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8 Supra, p. 316.

9 Table of Organization 8-77, 1 Mar. 1942. "This table supersedes T/O 8-77 and 8-78, both dtd. 5 Nov. 1940" - tables referred to on p. 295, supra.

10 Rpt. to M.D.T.C., fr. Subcommittee on Field Equipment, 16 Sep. 1942, subject: "Surgical Trucks for the Armored Force, Medical Company" (A.M.R. & D. Bd.).

11 Ibid.

12 Ltr. to Hq., S.C.S., fr. Research & Development Div., S.G.O., 7 Oct. 1942; subject: "Surgical Truck for Armored Force, Medical Company" (A.M.R. & D. Bd.).

13 1st Ind. to Chf., Development Br., Requirements Div., S.C.S., 21 Oct. 1942; basic: see n. 12, above (A.M.R. & D. Bd.).

14 2d Ind. to S.G.O., fr. Requirements Div., S.C.S., 28 Oct. 1942; basic: see n. 12, above (A.M.R. & D. Bd.).

15 Ltr. to C.G., A.G.F., fr. Hq., Armored Force, Ft. Knox, Ky., 31 Oct. 1942; subject: "Elimination of Ladder on Surgical Truck"; et passim (Rec. Rm., S.G.O. 451.2-1).

16 Ibid.

17 2d Ind. to T.S.G., fr. Hq., S.O.S., 16 Nov. 1942; basic: see n. 15, above (Rec. Rm., S.G.O. 451.2-1).

18 3rd Ind. to Deputy Chf., Ord. Tank-Automotive Center, Detroit, Mich., 4 Dec. 1942; basic: see n. 15, above (Rec. Rm., S.G.O. 451.2-1).

19 4th Ind. to T.S.G., fr. Engineering Br., Tank-Automotive Center, Detroit, Mich., 3 Feb. 1943; basic: see n. 15, above (Rec. Rm., S.G.O. 451.2-1).

20 Ltr. to Deputy Chf., Ord. Tank-Automotive Center, Detroit, Mich., fr. S.G.O., 23 Feb. 1943; subject: "Truck, 2 $\frac{1}{2}$ -ton, 6x6, Surgical" (Rec. Rm., S.G.O. 451.2-1).

The Armored Divisions named in the requisition are the 7th, 8th, 9th, 10th, 11th, 12th, 13th and 14th.

21 Ltr. to the C.G., Hq., Armored Force, Ft. Knox, Ky., fr. S.G.O., 22 Mar. 1943; subject: "Truck, 2½-ton, 6x6, Surgical" (A.M.R. & D. Bd.).

22 Ibid.; et passim.

23 3rd Ind. to C.G., Armored Force, Ft. Knox, Ky., fr. Pres., Armored Force Bd., 6 Apr. 1943; basic: see n. 21, above (A.M.R. & D. Bd.).

24 Ibid.

25 4th Ind. to T.C.G., A.G.F., fr. Hq., Armored Force, 8 Apr. 1943; basic: see n. 21, above (A.M.R. & D. Bd.).

26 6th Ind. to T.C.G., A.S.F., fr. S.G.O., 23 Apr. 1943; basic: see n. 21, above (A.M.R. & D. Bd.).

27 7th Ind. to T.S.G., fr. Development Br., Requirements Div., Hq., A.S.F., 27 Apr. 1943; basic: see n. 21, above (A.M.R. & D. Bd.).

28 Ltr. to T.S.G., fr. Dir., M.D.E.L., 6 Apr. 1943; subject: "Surgical Trucks" (A.M.R. & D. Bd.).

29 Ibid.

30 3rd Ind. to C.G., S.C.S., fr. Hq., Armored Force, Ft. Knox, Ky., 12 Mar. 1942; basic: ltr. to T.S.G., fr. Dir., M.D.E.L., 7 Feb. 1942; subject: "Surgical Truck for Clearing Company, Armored Force" (Rec. Rm., S.G.O. 451.2-1).

31 5th Ind. to T.S.G., fr. M.D.E.L., 24 Mar. 1942; basic: see n. 30, above (Rec. Rm., S.G.O. 451.2-1).

32 See Chapter X, infra.

33 Ltr. to Dir., M.D.E.L., fr. S.G.O., 15 Jun. 1943; subject: "Tentative Changes in Truck, 2½-Ton, 6x6, Surgical" (A.M.R. & D. Bd.).

34 Ltr. to Dir., M.D.E.L., fr. The Surgeon, Hq., Armored Force, 28 Jun. 1943 (A.M.R. & D. Bd.).



35

Ibid.

36

Memo. to T.C.G., A.G.F., fr: Chf., Operations Service, S.G.O., 18 Apr. 1944; subject: "Truck, 2½-Ton, 6x6, Surgical (Armored Force)" (A.M.R. & D. Bd.).

37

1st Ind. to C.G., A.S.F., fr. Hq., A.G.F., 22 Apr. 1944; basic: see n. 36, above (A.M.R. & D. Bd.).

38

2d Ind. to Research & Development Div., S.G.O., fr. Hq., S.O.S., 28 Oct. 1942; basic: ltr. to Hq., S.O.S., fr. Research & Development Div., S.G.O., 7 Oct. 1942; subject: "Surgical Truck for Armored Force, Medical Company" (A.M.R. & D. Bd.).

39

Memo. to Chf., Operations Service, fr. Chf., Catalog Br., S.G.O., 29 Apr. 1944; subject: "Item 99590-Truck, Surgical" (A.M.R. & D. Bd.).

40

1st Ind. to T.S.G., fr. Deputy Dir., Plans & Operations, A.S.F., 12 May 1944; basic: ltr. to C.G., A.S.F., fr. Chf., Operations Service, S.G.O., 9 May 1944; subject: "Item 99590, Truck, Surgical" (A.M.R. & D. Bd.).

41

Memo. to Chf., Supply Service, S.G.O., fr. Dir., Technical Div., S.G.O., 20 May 1944; subject: "Item 99590, Truck, Surgical" (A.M.R. & D. Bd.).

42

Min. of M.D.T.C., 29 May 1944, RESTRICTED (Rec. Rm., S.G.O. 451.2-1). Extracted in clear.

43

Ltr. to T.S.G., fr. Hq., Armored Force, Ft. Knox, Ky., 11 Sep. 1942; subject: "Procurement of Surgical Trucks and Black-Out Tents" (A.M.R. & D. Bd.).

44

Requisition No. S.G.O. P-305 General, 6 Jan. 1943 to Chf. of Ord., fr. S.G.O.; et passim (Rec. Rm., S.G.O. 451.2-1).

According to information obtained from the Detroit Automotive Motor Center, Army Ordnance Department, Detroit, Michigan, the cost of the body was \$2,259.89 and the cost of the chassis was \$1,907.84--or a total cost for the complete surgical truck of \$4,167.73. (Memo. to Maj. Tarbet, fr. George F. Smith, Capt., Sn. C.; 29 Mar. 1943 - A.M.R. & D. Bd.). Medical Supply Catalog, Army Service Forces Catalog MED-3, 1 Mar. 1944, lists the unit-price as \$4,167.

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- 45 Ltr. to Deputy Chf. of Ord. Tank-Automotive Center, Detroit, Mich., fr. S.G.C., 23 Feb. 1943; subject: "Truck, 2<sup>1</sup>-Ton, 6x6, Surgical" (A.M.R. & D. Bd.).
- 46 2d Ind. to S.G., fr. Tank-Automotive Center, Detroit, Mich., 6 Mar. 1943; basic; see n. 44, p. 351 (A.M.R. & D. Bd.).
- 47 Ibid.
- 48 Memo. to Col. S.B. Hays, Distribution Div., fr. Chf., Field Equipment Br., Plans Div., 9 Mar. 1943 (A.M.R. & D. Bd.).
- 49 Ibid.
- 50 Memo. to Cols. Klopp, Fenton, Hays, and Ghormley, fr. R.L. Black, Lt. Col., M.A.C. [S.G.C.], 11 Mar. 1943, CONFIDENTIAL (A.M.R. & D. Bd.). Extracted in clear.
- 51 Telegram to C.G., A.S.F., fr. Joyce, C.G., Ft. Douglas, Utah, 6 Jul. [1943].
- 52 Ltr. to C.G., A.G.F., fr. S.G.C., 12 Jul. 1943; subject: "Surgical Trucks" (A.M.R. & D. Bd.). Note inclosed copies of telegrams dtd. 8 and 10 Jul. 1943.
- 53 Memo. to Dir., Distribution & Requirements Div., fr. Chf., Field Equipment Development Br., Plans Div., 29 Oct. 1943; subject: "Request for Trucks, Surgical" (A.M.R. & D. Bd.).  
Although the request, contained in this memorandum, "that nineteen (19) Trucks, Surgical, now in storage, be shipped to the Medical Department Equipment Laboratory, . . . as soon as possible, for conversion" was quickly cancelled (Memo. to Dir., Distribution & Requirements Div., fr. Chf., Field Equipment Development Br., Plans Div., 2 Nov. 1943; subject: "Request for Cancellation of Memorandum, 28 Oct. 1943" - A.M.R. & D. Bd.), plans actually to convert surgical trucks into dental units were not abandoned. (See memo. to Chf., Program Planning Br., fr. G.H. Davis, Capt., M.A.C., 24 Nov. 1943; subject: "Item 99590, Surgical Trucks" - A.M.R. & D. Bd.).
- 54 Memo. to Chf., Program Planning Br., fr. G.H. Davis, Capt., M.A.C., 24 Nov. 1943; subject: "Item 99590, Surgical Trucks" (A.M.R. & D. Bd.).



55 1st Ind., to Procurement Div., fr. Chf., Field Equipment Development Br., Plans Div., 26 Nov. 1943; basic: memo. to Chf., Field Equipment Development Br., Plans Div., fr. Chf., Program Planning Br., 25 Nov. 1943; subject: "Item 99590, Surgical Trucks" (A.M.R. & D. Bd.).

56 For authorized distribution of the surgical trucks by theaters of operations, see the following communications: ltrs. to C.G., NATOUSA, fr. Chf., Supply Service, S.G.O., 26 Oct. 1944; subject: "Medical Department Trucks"; to C.G., ETO, fr. Chf., Supply Service, 26 Oct. 1944; subject: "Medical Department Trucks", CONFIDENTIAL (Rec. Rm., S.G.C. 451.2). Extracted in clear.

The following table shows distribution to the various theaters authorized to receive the trucks:

	<u>By 31 Dec. 1944</u>	<u>By 31 Dec. 1945</u>
POA	0	0
NATOUSA (MTOUSA)	6	6
CBI	0	0
South Pacific Base Command	0	0
ETO	66	84
SWPA	0	0

57 AR 850-25, 23 Jul. 1936, passim.





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## THE ARMY MOBILE MEDICAL LABORATORY.

I. Historical Background.A. The Semi-Mobile Laboratory.

The Army Medical Laboratory which was in standard use for two decades following World War I was a far cry from the highly mobile, flexible, and self-contained unit which is in such widespread demand today. In at least three important respects this earlier Laboratory, despite its motorized transportation, possessed limitations which prevented it from functioning as a truly mobile unit. To begin with, instead of being organized into several sections, the World War I Laboratory was constituted as a single inflexible unit, allotted on the basis of one per field Army. So constituted, it tended to remain largely in the Army area as it was organically incapable of sending out sub-sections, equipped to function independently for short periods of time, to provide emergency field laboratory service for the Corps areas. In short, assistance to Corps areas could be rendered only at the expense of laboratory service in the Army area.<sup>1</sup>

The mobility of the World War I Medical Laboratory was also limited in a second important respect. The unit lacked completely any self-contained or even partially specialized laboratory vehicles. As prescribed by the Tables of Organization and the Tables of Basic Allowance which were in force during the early twenties and which were only slightly modified thereafter, integral transportation for the Army Medical Laboratory consisted of one light 5-passenger motor car, two motorcycles with sidecar, and three  $1\frac{1}{2}$ -ton light cargo trucks.<sup>2</sup> Since no provisions had been made for the carrying on of routine laboratory activities within any of these vehicles, all work of this nature had to be performed in the field. This meant that in moving into a new location a great deal of preliminary labor had to be expended before the Laboratory could begin to function. Tents had to be pitched; utility equipment such as electric power generators, water tanks, stoves, refrigerators and autoclaves, had to be unloaded from the trucks and reassembled; all specialized laboratory instruments and supplies had to be unpacked, sorted, and arranged before systematic operation was possible.

The third, and perhaps the most serious, defect of the World War I Laboratory was the awkward and burdensome method which had been adapted for the packing and transporting of laboratory equipment. Such equipment had to be

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painstakingly hand-packed in heavy medical Department chests. Due to the excessive handling involved, the possibilities of breakage were high and, even more important, loading and unloading operations under such a system became onerous and time-consuming in the extreme. Furthermore, before moving the unit, culture media, certain biologicals, diagnostic sera, and stock laboratory solutions--all requiring considerable time and effort to prepare--had to be discarded before their containers could be packed in the chest. Then upon arrival at the new location, valuable time was lost while the solutions which had been previously destroyed were prepared anew.<sup>5</sup> Finally, there was the ever present danger of acid damage. The breakage of a small, 30 cent acid bottle which was contained in a \$200 chest filled with expensive equipment could prove disastrous. This contingency, it may be pointed out, was a source of worry to Medical Department officials as recently as 1937.<sup>4</sup>

While the above disadvantages, at least from present perspective, might seem to have constituted ample justification for an immediate and drastic modification of the authorized equipment of the Army Medical Laboratory, the records indicate that only small-scale and sporadic experimentation was engaged in until 1939. In the years immediately following World War I, a special purpose trailer was developed to function as a part of the Laboratory for use in the rear of the Army area.<sup>5</sup> An examination of Tables of Organization and Tables of Basic Allowance, however, shows that this item was never incorporated into official lists of standard issue Laboratory equipment. In 1928, the Medical Department Equipment Laboratory at Carlisle Barracks built a second experimental trailer for the Laboratory but the trailer had no heat, light, nor a sheltered place for personnel, and after considerable testing was rejected.<sup>6</sup> In 1933, The Surgeon General, after studying the needs of the Army Medical Laboratory, expressed a preference for a semi-trailer or bus type vehicle. Construction of a semi-trailer was thereupon authorized, but lack of funds for the work caused delay until late in the Fiscal Year 1939.<sup>7</sup>

In short, throughout the period from 1919 to 1939, the Army Medical Laboratory remained virtually unaltered. Equipment list items continued to be packed in heavy laboratory chests, while the sole change in vehicular equipment consisted in the replacement in 1927, of one of the three  $1\frac{1}{2}$ -ton cargo trucks with a  $3\frac{3}{4}$ -ton cargo truck.<sup>8</sup>

#### B. The Mobile Laboratory.

The fact that the Medical Department, in 1933,



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rejected the Equipment Laboratory's experimental trailer because it "had no heat, light, nor a sheltered place for personnel,"<sup>9</sup> indicates that at least by this date serious consideration was finally being given to the need for a truly specialized and self-contained laboratory vehicle to take the place of the general-purpose cargo truck. In June, 1934, an important event occurred which gave both direction and impetus to this new approach to the problem. On that date the Pennsylvania State Board of Health demonstrated before medical officers at Carlisle Barracks a radically new type of field laboratory.<sup>10</sup> It consisted structurally of a special York-Hoover body (19 feet 8 inches long, 7 feet 6 inches wide, and 7 feet 5 inches high), mounted on an elongated autocar chassis (16 feet 4 inch wheelbase), and equipped with single front and dual rear wheels. Inside laboratory space measured 16 feet by 7 feet by 6 feet 2 inches, and an aisle three feet wide separated the low tables which lined the walls on both sides.

The vehicle was, in effect, a virtually self-contained laboratory on wheels. Ceiling lights had been provided, the interior was wired for electricity which could be used for heating purposes when commercial power was available, and gas tanks and storage batteries were included as supplementary power sources. Among the other interior fittings were screened windows, a built-in sink and drain board with hot and cold water connection, side ventilators, tables, bottle racks, and special cabinets with drawer space sufficient for the storage of all loose laboratory equipment. There was under-floor storage space for tools, and standard heavy equipment, such as stoves, incubators, refrigerators, and autoclaves, were installed in the laboratory proper. Two solid rows of table tops provided an ample working surface for laboratory personnel.

The advantages of this model mobile laboratory were self-evident. With loose laboratory equipment stored in cabinet drawers, instead of heavy Medical Department chests (with acid bottles segregated into a separate drawer), not only was there virtually no packing involved in moving from one location to another, but a considerable portion of the work could be performed right inside the vehicle. The dangers of breakage and acid damage were largely eliminated, the time and effort involved in loading and unloading were reduced to a minimum, and the unit was capable of operation even in the most inclement weather. Furthermore, in view of the greatly increased mobility and self-sufficiency of this new vehicle, the notion of increasing the flexibility of the standard Army Medical Laboratory by subdividing it into several laboratory sections appeared suddenly feasible.

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### C. Summary.

Due to a lack of funds, the Medical Department was unable to begin construction of an appropriately modified form of the above mobile laboratory until the year 1939.<sup>11</sup> During the evolutionary period which has just been described, however, the direction of future research in this field had been fairly well determined. The limitations of the old Army Medical Laboratory had become increasingly apparent, and now, since the demonstration of the Pennsylvania State Board of Health's laboratory model, the general outlines of a practical alternative were fairly clear. All that was lacking at this point were funds and personnel to perform the indicated development work.

## II. Project Initiation (Phase I).

### A. Initial Project Proposal.

Included in the estimate of funds for medical research and development for Fiscal Year 1939, was the sum of \$500 to be allotted for the specific purpose of developing a mobile laboratory.<sup>12</sup> While this sum, of itself, would have been insufficient for the major research undertaking that was necessary, an unexpected turn of events opened up the possibility of obtaining, cost free, a completely constructed semi-trailer which would be ideal for experimental purposes. A 2-wheel, semi-trailer van had been procured for the Medical Department by the Quartermaster General with a view to its being converted into a mobile operating room, a unit of the new surgical hospital then under development at Carlisle Barracks. However, one such operating unit had already been completed and, until it had been thoroughly tested, it was considered inadvisable to assemble a second unit.<sup>13</sup> Thus the semi-trailer van just procured, was, for the time being, a surplus item.

The Surgeon General's Office acted quickly to seize this opportunity, and on 24 January 1939 directed a letter to The Adjutant General requesting that authority be granted to use the semi-trailer van then at the Holabird Quartermaster Depot for the development of a mobile laboratory. In justifying a full scale reopening of the research project which had been authorized in 1933 but had never been worked on, The Surgeon General's Office emphasized the present desirability of having an Army Laboratory which, instead of the old single unit type, would consist of a base laboratory section to serve in the Army area and three mobile subsections to serve farther forward in the Corps areas. It was pointed out that the mobility of this unit was of greater importance than ever because the laboratory section origi-

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nally included in the service company of the medical regiment had been deleted from new tables of organization, with the view that the laboratory work previously performed by this unit could be better accomplished by the Army Medical Laboratory.<sup>14</sup>

The inefficiency and relative immobility of the Army Medical Laboratory as then constituted could, it was argued, be corrected by: (1) the use of cabinets, instead of Medical Department chests, for the storage of apparatus and equipment; and (2) the substitution of a modern semi-trailer van, equipped with electricity, running water, and other basic laboratory needs, in place of the currently employed all-purpose cargo truck. Thus modified the unit would be able to move at once from one location to another without having first to dismantle its equipment and destroy vital laboratory solutions. Finally, attention was called to the present existence of a suitable laboratory model--that of the Pennsylvania State Board of Health--and the fact that the adoption of such a mobile unit would be in keeping with the modern practices of many other state health boards.<sup>15</sup>

This well argued petition by The Surgeon General's Office for the reopening of Development Project, F-3, was successful. Within a few weeks The Adjutant General granted authorization for the mobile laboratory project, provided the semi-trailer van that had already been purchased for the Medical Department and was then at Holabird Quartermaster Depot was used for the experimentation.<sup>16</sup>

#### B. Procedural Aspects.

According to data on file in The Surgeon General's Office, Development Project, F-3, was first initiated 13 April 1933.<sup>17</sup> It will be recalled, however, that although the construction of a semi-trailer laboratory was authorized in that year, the funds were not forthcoming, and the project remained dormant until the beginning of 1939.<sup>18</sup>

The project request, submitted by the Medical Department in January, 1939, represented, therefore, a formal reopening of the whole question. As such it was subject to all the usual procedural requirements of AR 850-25 governing project initiation proposals.

While The Surgeon General's letter of 24 January 1939 contained an admirable statement of the purpose and justification of the proposed development project and a clear indication of the specific Medical Department vehicle and the specific research funds which were to be used, there was one important omission. No statement of military charac-

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teristics had been prepared, as required by Army Regulations. Moreover, this procedural error was not corrected by higher echelons. As we have seen, The Adjutant General approved the project request without comment as to its incompleteness.<sup>19</sup> It was not, apparently, until more than two years later that full compliance with this provision of AR 850-25 was accomplished. On 3 April 1941, in presenting its proposed research program for Fiscal Year 1941, the Medical Department included the following statement of military characteristics for Development Project, F-7:

**Military Characteristics:**

To provide preventive medicine facilities commensurate with an Army medical laboratory, by means of a mobile laboratory in a semi-trailer or bus-type vehicle, fully equipped for all epidemiological work in an Army area in time of war.<sup>20</sup>

There is no evidence at hand which would indicate that the above statement, which was subsequently approved without change by The Adjutant General's Office, was ever formally processed through the Medical Department Technical Committee, as required by Regulations. As for the substantive adequacy of this delayed formulation of military characteristics, the reader is referred for purposes of comparison to the military characteristics prepared during the second phase of this development project and, incidentally, carefully processed through all the agencies specified by AR 850-25.<sup>21</sup>

**III. Development Phase I.**

**A. Preliminary Survey.**

Because of circumstances beyond their control, research and development personnel found themselves forced to plunge into actual development work without making even a token survey of all existing research possibilities. As we have seen, the Medical Department was already committed to confining its experimentation to the semi-trailer van which was then on the shop floor of the Holabird Quartermaster Depot. This decision, limiting the scope of the project to a single possibility, had been made solely on grounds of expediency, yet it would be difficult to criticize the Medical Department for its action. The project had been virtually dormant for six years due to a lack of funds, and here was an opportunity to pre-empt an unclaimed vehicle which might be converted into at least a crude approximation of a genuinely mobile laboratory.

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With only \$14,500 allotted to the Medical Department for all types of research and development for the Fiscal Year 1940,<sup>22</sup> it is not difficult to see why, in this instance, research policy was so heavily influenced by the mere availability of a cost-free vehicle. Whatever its immediate justification, however, such an opportunistic research policy possessed certain definite limitations. In the first place, due to the lack of funds, none of the commercially available alternatives to the semi-trailer van could be seriously considered. As we shall see, such possible alternatives included: (1) the Pennsylvania State Board of Health model; (2) the 1½-ton cargo truck-house trailer combination of the U. S. Public Health Service; (3) the General-Electric Century of Progress mobile unit.

In the second place, having committed itself to experiment exclusively with the semi-trailer van, the Medical Department was unable to obtain authorization to work on any other vehicle, however promising, even though it also could be made available cost free. The front-drive, bus-type ambulance, for example, was available for general experimental purposes as early as July, 1940. Research and development personnel immediately expressed a desire to try to convert this vehicle into a mobile medical laboratory. The Surgeon General's Office, in fact, formally attempted to substitute this bus type truck for the semi-trailer specified for Project F-3, but this request was refused by The Adjutant General's Office which ruled that the project had to be completed as originally outlined.<sup>23</sup>

Had this project been adequately financed, a thoroughgoing study of all the above research possibilities could have been made before actual development work began. As it was, awareness of promising alternatives to the semi-trailer van was coupled with inability, on the part of research and development personnel, to give serious consideration to any of them. These were far from ideal research conditions and, as we shall see presently, they did not produce impressive results.

#### B. Developmental Stage.

As soon as the Medical Department Equipment Laboratory at Carlisle Barracks learned that the initiation of Development Project, F-3, would be approved by higher authority, it immediately took steps to obtain a tentative list of the equipment and supplies which were to be installed in the new laboratory. On 2 February 1939, the following letter was sent to Army Medical Center, Washington, D. C.

1. A project has been authorized by The Surgeon General for the equipment of a large

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semitrailer vantage body as a mobile laboratory.

2. This trailer is similar in size and shape to the one recently procured and equipped as an operating room for a surgical hospital.

3. It is requested that this office be furnished with a tentative list of equipment and supplies considered by you to be necessary for work of this unit in the field.

4. In so far as the equipment is concerned, it will not be necessary to furnish data on voltage, power units, and so forth.<sup>24</sup>

Inasmuch as there were ample shop facilities at the Holabird Quartermaster Depot, where the semi-trailer was still being housed, it was decided that the bulk of the construction work could be performed at that point, with the Equipment Laboratory at Carlisle merely exercising general supervision. Accordingly, in a letter dated 25 April 1939, the Laboratory forwarded to the Depot detailed instructions as to the changes which were to be made in the vehicle and agreed to allocate eight hundred and fifty dollars from its local research funds to cover the costs of the work.<sup>25</sup>

The structural changes specified at this time included the following: (1) side and end walls and ceiling to be insulated; (2) four single plate-glass windows on each side, and one plate-glass window for the front end of the body; side windows to slide up and down, and windows to open outward; (3) a row of ceiling electric light fixtures on each side of the trailer, and two forward ceiling fixtures in the center line; four wall sockets on each side and one on the front wall; (4) upright 50-60 gallon pressure water tank to be installed in left front corner of body; (5) one stainless steel sink, with drainboard, centered across the front of the body; sink to have only a cold water faucet; drainage by pipe through floor (6) compressor and small motor for maintaining water pressure at the faucet (7) the necessary piping and plumbing to connect water tank and sink; (8) exhaust ventilating fan in front end of body, right upper quadrant; (9) tempered presswood covering for floor; (1) ceiling to be painted flat white, sides and ends sea-green; outside painting to be the same as for previously finished bodies.<sup>26</sup>

The working relationship which was maintained between the Equipment Laboratory and Holabird Quartermaster Depot during these early months was a model of efficiency. The initial instructions issued by the Laboratory had been both concrete and comprehensive, and as a result subsequent correspondence was held at a minimum. Before the close of May, 1939, construction details had been carefully blue-printed and some of the heavy equipment which was to be

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installed by the Depot had already been selected.<sup>27</sup>

Since the equipment lists which had been requested from Army Medical Center had not yet been received, the Equipment Laboratory next turned its attention to the question of cabinets, tables, and table top coverings. Cabinets with shelves and drawers would be needed in the mobile laboratory for the storage of chemicals and other equipment and supplies, but it appeared to be useless to attempt any elaborate designing of cabinets until the total amount and variety of equipment to be stored were known.

However, there was no reason why the Laboratory could not begin work immediately on the design and construction of suitable laboratory tables. It was already assumed that laboratory technicians would perform a large number of their analyses inside the truck; hence a broad, level working surface was necessary. After considerable discussion it was finally decided that two long tables, sufficiently high to fit over the storage cabinets which were to line each side of the laboratory interior, would adequately serve this purpose. It was also necessary, however, to discover some effective way of treating the tops of these tables so that they would be rendered acid and alkali proof, and resistant to marring.

The development of a satisfactory table was a comparatively simple undertaking. After a brief preliminary study it was determined that the tables should be approximately 28 inches wide and 12 feet long, and should be constructed of tongue and groove maple wood.<sup>28</sup> Selection of a suitable covering for the table tops, however, proved to be more difficult. Preliminary examination seemed to indicate that either hard rubber or stainless steel might be satisfactory, but before arriving at a final decision the Laboratory took the precaution of consulting a number of well-known commercial firms. From the American Hard Rubber Company the Laboratory learned that hard rubber was attacked by strong sulphuric and nitric acid, and was also affected by the common rubber solvents. Only if these chemicals were quickly washed off with a quantity of water could the rubber be expected to render good service.<sup>29</sup> From the Monsanto Chemical Company it was learned that the only plastic which was acid resistant was a special molding compound (Polystyrene) which would not be practical for the use intended.<sup>30</sup> Ebony finishes were also tested by the Laboratory, but were not found to be satisfactory.<sup>31</sup> Finally, B. F. Goodrich Company was contacted for information on "Acidseal" paint as a finish for the laboratory table tops. The Goodrich Company suggested their #1045 paint as suitable, a sample was requested, and the paint subsequently applied to a maple table top assembled with waterproof glue.

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This time the results were satisfactory and acidseal paint was thereupon selected by the Laboratory as the best of the protective finishes.<sup>32</sup>

In the absence of any written directives from The Surgeon General's Office clearly distributing responsibility for the various phases of Development Project, F-3, the Equipment Laboratory had, as we have seen, unofficially assumed the role of coordinator of research activities in addition to its regular developmental duties. In our discussion thus far, it would appear that the functions which the Laboratory had, so to speak, delegated to itself were well within its province. The same cannot be said, however, with regard to certain procurement activities in which the Laboratory was also engaging at this time.

In a letter, dated 2 February 1939, responsibility for the preparation of a tentative equipment list had been assigned by the Laboratory to Army Medical School. Yet two days later, on 4 February 1939, the Equipment Laboratory circularized two manufacturers, the Coleman Lamp and Stove Company and the American Machine Gas Company, for information regarding portable gasoline stoves.<sup>33</sup> Negotiations were continued and finally a Coleman stove was purchased out of Laboratory funds for \$46.16. Moreover, as we shall see in a moment, equipment purchases by the Laboratory were not to be confined to this one relatively unimportant item but were to continue, involving ultimately a gross expenditure of nearly \$800.

On 29 March 1940, Holabird Quartermaster Depot notified the Equipment Laboratory that its work on the mobile laboratory had been completed, and, within a week the vehicle was delivered to Carlisle Barracks.<sup>34</sup> In cooperation with the Director of Sanitation, Medical Field Service School, Carlisle Barracks, final drawings were made of the laboratory tables which were to be installed in the trailer, and the necessary lumber, paint, angle iron, and hardwood were procured. The table tops and framework for the tables, were then constructed during April and May. Further work was delayed pending receipt of the equipment list which was to be prepared by the Army Medical School. It was felt that the inside of the cabinets and drawers should be built around this equipment in order to insure its safety when the trailer was moving from one location to another.<sup>35</sup>

As for the heavier equipment which was to be individually installed rather than packed in drawers, the Laboratory was not so patient. Immediately upon receipt of the trailer from Holabird Quartermaster Depot, the Equipment Laboratory obtained from the head of the Department

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of Sanitation, Medical Field Service School, a list of all so-called "fixed equipment" which would be needed. The following items were selected and subsequently requisitioned by the laboratory.<sup>36</sup>

Item 99782, Generator, gasoline, 1500 watt ..	\$400.00
Item 73770, Refrigerator, electric .....	76.66
Item 41390, Centrifuge .....	18.00
Item 44010, Sterilizer, Arnold .....	20.00
Item 94010, Autoclave, field .....	20.00
Item 94320, Incubator, field, two (2) .....	190.00
Total .....	726.66

It should be remembered, of course, that Army Medical School had already had fourteen months in which to prepare a tentative equipment list, but as yet had apparently done nothing about the matter. Such an extraordinary delay certainly furnished considerable provocation for the action which was now taken by the Equipment Laboratory. In view of later developments, however, it will be seen that a more effective recourse would have been to appeal to The Surgeon General's Office for a forceful, central direction of the project from this point on. The absence of any real research coordination at the top had been a conspicuous administrative weakness from the beginning.

In any event, on 10 May 1940, the Director of the Department of Sanitation at Carlisle Barracks was relieved and was replaced by a new Director who, soon after his arrival, inspected the mobile laboratory and suggested that the Director of Army Medical School come to Carlisle and see what work had been done thus far on the trailer. The latter visited the Equipment Laboratory on 26 June, inspected the vehicle, and requested blueprints of the tables which had been constructed. These were furnished on 9 July 1940.<sup>37</sup>

Then the inevitable happened. On 5 August 1940, the Director of the Equipment Laboratory received a memorandum from the Director of the Army Medical School, requesting: (1) that the sterilizer purchased by the Laboratory be replaced by a nonstandard unit manufactured by the Bramhall Deane Company; (2) that the gasoline stove purchased from Laboratory funds be replaced by a special burner to be developed by the Jeffersonville Quartermaster Depot; (3) that the refrigerator already requisitioned be replaced by a nonstandard item, the exact type to be selected at a later date by the Director of the Army Medical School; (4) that the kerosene-operated incubators be replaced by electric incubators.<sup>38</sup>

In addition to these written recommendations, it was learned informally by the Equipment Laboratory that the

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Director of the Army Medical School desired that the gasoline-operated electric generator now installed in semi-permanent fashion, be so housed in the rear of the trailer that it would not have to be moved outside the vehicle at all, and that the position of the exhaust be changed in such a way that the fumes could be conducted out through holes in the side of the trailer. It was also understood that the procurement of an additional generator was contemplated by Army Medical School.<sup>39</sup>

In short, Army Medical School was recommending that virtually all of the fixed equipment which had been procured or requisitioned by the Laboratory should now be discarded; to be replaced at some time in the future by items selected exclusively by Army Medical School. If these suggestions were adopted, Development Project, F-3, would, in effect, come to a virtual standstill; for Army Medical School had not yet submitted a list of equipment which was to be fitted into the laboratory cabinets and drawers, although eighteen months had now elapsed since it had first been requested to do so.

At precisely this crucial juncture, the Equipment Laboratory received the following letter from The Surgeon General's Office, written, apparently, in unawareness of the serious deadlock which was then being threatened.

We are interested in knowing how the Laboratory Trailer Project is coming along. It of course should be finished as soon as practicable so that drawings and specifications can be prepared for the purchase of a number of these for Army medical laboratories. The new table of organization for that unit provides that each Army laboratory shall have as an organic part of it three of these mobile units, each mounted in a truck or trailer body.<sup>40</sup>

It is difficult to conceive how The Surgeon General's Office could have lost touch with Development Project, F-3, to the extent suggested by the foregoing comments. The changing of the table of organization of the Army Medical Laboratory to provide for three additional mobile units per field army would seem to have been based on an all too sanguine expectation that the project was on the verge of being successfully completed. If such was indeed the case, the Equipment Laboratory lost no time in correcting the false impression. On 3 September 1940, the Laboratory directed a vehement letter to The Surgeon General's Office, describing in detail the serious difficulties which it was having with Army Medical School, and concluding with the following vigorous statements:



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4. It is impossible for the Equipment Laboratory to proceed with this project until it is informed definitely as to requirements and supplied with the equipment to be contained therein. It has been the desire of this laboratory to complete this project, which it could have done easily in the past three (3) months; during this time there have been no important projects requiring the services of the carpenter and the blacksmith.

5. It is believed that this project should be completed at once, for much work will be necessary and practically all the facilities of the Equipment Laboratory made available for experimentation and testing of the bus type ambulance and the new 4 x 4 ambulance, upon their arrival; this in addition to the projects placed by the Office of The Surgeon General.

6. Regardless of how this unit is built inside and how equipped, inasmuch as it is in an experimental project, certain minor changes structurally as well as changes in equipment will have to be made when the unit is tested; regardless of who builds it or who selects the equipment.

7. Recommendations.

a. It is recommended this project be completed as originally planned and equipped with the equipment now in the Equipment Laboratory selected originally and as given in paragraph 3 above.

b. And that the remaining equipment to be selected by a board appointed for that purpose; or selected by the Director of the Army Medical School, be forwarded to the Equipment Laboratory without delay, in order that this Laboratory may build proper spaces in the Army Medical Laboratory, for its storage.<sup>41</sup>

This strongly-worded letter produced results. On 13 September 1940, a conference was held at The Surgeon General's Office in Washington at which The Surgeon General's Office, Army Medical School, and the Medical Department Equipment Laboratory, were all represented. It was agreed that completion of the experimental Army Mobile Medical Laboratory should be attained at the earliest possible moment; that, in order to expedite the matter a requisition for all property to be installed in the labo-

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ratory would be submitted immediately by the Director of Army Medical School; that this requisition would first go to The Surgeon General's Office for approval, then to the Medical Supply Officer, Carlisle Barracks, and finally to the Medical Section, New York General Depot for procurement--and that none of the funds currently available to the Equipment Laboratory would be used for this purpose. It was further agreed that if the special equipment desired by the Director, Army Medical School, was received in time it would be installed instead of the equipment originally purchased by the Equipment Laboratory.<sup>42</sup>

Five days later, on 18 September 1940, Army Medical School carried out its conference commitments by forwarding to The Surgeon General's Office a complete list of regular and nonstandard equipment for the mobile laboratory. In order to avoid further delay, the list had been made out on standard requisition forms.<sup>43</sup> On the following day the Plans and Training Division of The Surgeon General's Office approved the above mentioned equipment list without change and forwarded it to the Equipment Laboratory for action.<sup>44</sup> Unfortunately the Plans and Training Division had neglected to clear its action with the Supply Division of The Surgeon General's Office and this necessitated a short delay, involving the return of the original equipment list from Carlisle Barracks to Washington, and its re-transmittal to the Laboratory.<sup>45</sup>

By the latter part of November, 1940, however, the greater part of the requisitioned equipment was on hand and the Equipment Laboratory, wishing to get the project out of the way as quickly as possible so that other development work could proceed, urgently requested Army Medical School to send a representative to Carlisle Barracks to advise as to installation, and possibly as to the elimination of several items.<sup>46</sup> Accordingly, on 30 November 1940, an inspection visit to the Laboratory was made by a representative of Army Medical School, and upon his return to Washington a revised trailer list was prepared by Army Medical School and forwarded, 6 December 1940, to the Equipment Laboratory. The modified equipment list called for deletions of the electric centrifuge and hot air sterilizer included on the previous list, reduction of the original order for two gasoline burners to one of this item, and additions of a new type of nonstandard centrifuge and nonstandard prescription scales. It was further recommended that the trunk which had been installed in the left rear of the trailer be removed entirely from the laboratory and that the space be used instead as a cupboard to handle additional supplies.<sup>47</sup>

These proposals, threatening to revive once again

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the supposedly settled equipment controversy, elicited an immediate and heated protest from the Equipment Laboratory. In a second vigorous letter to The Surgeon General's Office, the Laboratory enumerated in detail the many points of difference which had arisen between it and Army Medical School since the initiation of Development Project, F-3, and the attendant difficulties and delays which had beset research and development personnel throughout this period. The mobile medical laboratory, it was pointed out, had been on the floor of the Equipment Laboratory for over eight months, and such work as had been done on it had been subsequently changed, and now must be changed again; equipment, requisitioned and purchased, had been changed, and was now being changed again. The latest proposed changes, the Laboratory stated, could be made but only at additional cost, time, and labor. Some assurance of permanency was definitely required and it was accordingly recommended that absolutely no further changes in equipment or interior construction be made, other than those now specified. It was also requested that the delivery of all equipment under requisition, or under special procurement be expedited.<sup>48</sup>

The above letter was forwarded by The Surgeon General's Office to Army Medical School with the comment that it was necessary that the installation and equipping of the medical laboratory be completed without further delay.<sup>49</sup> Army Medical School thereupon stated that it concurred with the recommendations of the Equipment Laboratory, namely that no further changes in equipment or interior construction be made and that delivery of all remaining supply items be expedited.<sup>50</sup> To which, in replying finally to the Laboratory, The Surgeon General's Office added its own assurances that no further changes were contemplated by that office.<sup>51</sup>

After this aggressive action by the Equipment Laboratory no further inter-office complications of importance arose to delay completion of the project. By 21 January 1941, much of the specified equipment had arrived and a tentative packer's list was prepared and forwarded to Army Medical School. Table tops were treated with acid-seal paint and were fitted into position, and hardware was installed on all cabinets and drawers which had been finished. Aside from painting the woodwork, all that remained to be done was to pack in the rest of the supplies which were slowly filtering in.<sup>52</sup> However, Army Medical School, apparently not even yet wholly converted to the notion that the time for further changes had definitely passed, suggested on 28 January 1941 that either a different type finish for the table tops be substituted for the already applied acid-seal paint, or that stainless steel be used instead of the painted maple wood top.<sup>53</sup> These recommendations the Equipment Laboratory conveniently ignored.

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Slow equipment deliveries continued to plague research and development personnel throughout the months of February and March. The Second Medical Laboratory, located at Fort Sam Houston, Texas, which had been designated to service test the mobile medical laboratory, had requested information in early January as to the approximate date at which it might expect shipment of the trailer.<sup>54</sup> After delaying its reply for two months, The Surgeon General's Office finally answered on 8 March 1941 that, while an early service test was desired by all concerned, no definite statement could yet be made as to the probable date when the new mobile laboratory would be available.<sup>55</sup>

By the first of April, 1941, virtually all supplies and equipment had arrived at the Laboratory. The Surgeon General's Office chose this occasion to issue the following rather cryptic directive:

1. In order to complete the experimental mobile laboratory and get it out for actual practical extensive field tests, it is desired that:

(a) The Director of Army Medical Schools prepare the list of apparatus and equipment which he recommends for this unit. The list to be in two parts, one, the apparatus to be installed, as incubators, sterilizers, etc., the other loose or packed equipment, as retorts, test tubes, dishes, etc. Lists to give sufficient data to permit easy identification for purchase or issue.

(b) The Director of the Equipment Laboratory at Carlisle Barracks to check over the list and determine the following:

(1) Can the apparatus and equipment as listed in (a) be installed and carried within the vehicle capacity?

(2) Can the apparatus be satisfactorily operated from the utilities available within the vehicle?

(3) An expression as to the roadability (i.e.) likelihood of apparatus being damaged by the movement of the mobile laboratory without extra special packing or securing.

2. In order to facilitate and expedite the completion of the mobile laboratory early compliance with paragraph 1, supra, is desired with the prompt return of the requested lists and comments, to this office.<sup>56</sup>

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Since both The Surgeon General's Office and the Equipment Laboratory had long before received copies of the last revised equipment list prepared by Army Medical School, the inference in paragraph 1 of the above communication would seem to be that another equipment revision was in the making. If so, was the Laboratory to replan its packing arrangements once more? Was the process of requisitioning to begin all over again? If changes such as these were contemplated, it is difficult to see how, especially at this late stage, The Surgeon General's Office was "expediting" and "facilitating" the completion of the project.

Fortunately, Army Medical School made it clear in its reply to The Surgeon General's Office that further postponement of service tests was not desired. While a new supply list for the trailer laboratory was forwarded as directed, it was explicitly recommended that no effort be made at this time to require the Laboratory to conform to the new list. Instead it was suggested that if either units or amounts now specified were not in agreement with what had already been packed on the trailer, the discrepancy should merely be noted in pencil on the new list. It was urged that the laboratory be given a road test as soon as possible and then sent to Army Medical School for a more extended service test.<sup>57</sup>

This avoidance, by Army Medical School, of a reopening of the equipment controversy cleared the way for a definite termination of development activity. Within ten days the Equipment Laboratory had completed all unfinished work on the interior of the trailer and had packed away all remaining items of equipment. The new mobile medical laboratory was at last ready to be tested. Counting all delays and postponements, the finished product represented an expenditure of time and effort on the part of research and development personnel, extending over a period of 27 months.

### C. Road and Field Testing.

On 24 April 1941, the trailer laboratory was given a 60-mile road test by Equipment Laboratory personnel and, on the following day, an additional 81-mile test was given. A formal report of the results of these two tests was then submitted to The Surgeon General's Office. In brief, the findings were as follows:

The complete unit shows good roadability over all types of roads. It exhibits comparatively easy handling, and the power unit can pull the trailer

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without effort notwithstanding the fact that it is necessary to use low gear on long hills.

The equipment and supplies rode well over all types of terrain; no changes in installations are recommended.<sup>58</sup>

In the body of the report, mention was made of the fact that the height of the trailer (approximately 11 feet) had caused some difficulty ("low hanging branches of trees on the dirt roads would strike the front and top portions of the vehicle, and at times fairly large branches would strike the windows in the front of the trailer"). On one occasion the driver had taken a wrong turn and had entered a small park with a narrow winding road bordered with trees. Because of the bulk of the vehicle and the number of low-branched trees in the rear, it was considered impossible to back out and the driver was forced to continue through the park instead of returning immediately to the main road.<sup>59</sup>

Evidently these difficulties were considered minor. The Equipment Laboratory's summary of its test findings, quoted above, was highly favorable.

In any event, upon completion of the road tests at Carlisle Barracks, arrangements were immediately initiated to ship the trailer laboratory to Army Medical School for further testing. Since no tractor had been assigned to the semi-trailer, there was some delay in obtaining a vehicle to haul the laboratory to Washington. This problem was presently solved and actual transfer of the trailer laboratory to Army Medical School was accomplished 2 July 1941.<sup>60</sup>

After the laboratory had been carefully checked over by Army Medical School, action was initiated to ship the semi-trailer unit to the Second Medical Laboratory, then located at Lake Charles, Louisiana, for an extended service test. On 16 August 1941, The Surgeon General's Office issued the following test instructions to the Second Medical Laboratory:

It is desired that this trailer laboratory be given thorough and complete field tests, and a full report submitted to this office on the completion of these tests.

It is desired that the following points be specifically covered in the report.

- a. Roadability of the trailer unit
- b. Adequacy of provisions for packing and carrying the equipment without breakage or damage.

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- c. Adequacy of the equipment and apparatus to carry out the technical work expected from this unit.
- d. In your opinion, can a mobile unit of this type be employed in the manner and for the purposes contemplated, viz., Mobile Laboratory facilities for a field army?

The report should also include specific recommendations as a basis for future development, along similar or other lines, for Mobile Field Laboratory units.<sup>61</sup>

By the early part of September, 1941, transfer of the trailer laboratory from Army Medical School in Washington, D. C. to the Second Medical Laboratory at Lake Charles, Louisiana had been effected. The laboratory was extensively tested during Third Army Maneuvers which lasted from 3 September 1941 to 30 September 1941. At the conclusion of these field trials, a detailed report of findings was prepared by the Second Medical Laboratory and submitted to The Surgeon General's Office on 16 October 1941. These conclusions and recommendations, supported by nearly a month of careful observation in the field, were in marked contrast to those contained in the earlier Equipment Laboratory report.

It was concluded first of all by the Second Medical Laboratory that the semi-trailer, as constructed, was not a satisfactory vehicle for an Army laboratory. The trailer, it was pointed out, was too bulky and its ceiling was too high, making the vehicle topheavy and limiting maneuverability to hard-surfaced roads and parking areas — thereby defeating one of the prime purposes of a mobile field unit. Due to this same topheaviness, moreover, movement of personnel within the trailer set up such a floor motion, even when the trailer was stationary, that it caused considerable interference with microscopic work and use of the prescription balance. It was therefore recommended that, in place of the semi-trailer, consideration be given to the house trailer unit of the U. S. Public Health Service or the Century of Progress Unit of the General Electric Corporation. Only after drastic modification, it was pointed out, would the present trailer laboratory be satisfactory for the purpose intended.<sup>62</sup>

As for the interior fittings of the laboratory, both permanent and semi-permanent, only a few defects or omissions were noted, all of which were remediable. Similarly, while there was some difference of opinion as to the various items of laboratory equipment which had been selected by Army Medical School, and as to the various

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packing arrangements which had been adopted by the Equipment Laboratory, only minor changes were suggested. Above all, the Second Medical Laboratory registered its emphatic approval of the introduction of storage cabinets in place of Medical Department chests.

Recommendations:

. . . . .

D. That whatever the decision made as to what type mobile unit to be furnished the Army Medical Laboratories, the equipment and supplies be not stored in chests or crates, but the ample space in the form of drawers and cabinets be utilized to the fullest extent for their transportation. This cannot be too deeply emphasized, for by actual experience, it took five men a total of ten hours to pack and load the medical supplies of the Stationary Laboratory Section prior to one tactical move during the recent Third Army Maneuvers, whereas the Laboratory Trailer was ready to move within a few minutes after the order was received.<sup>63</sup>

IV. Termination of Phase I.

A. Project Discontinuance.

The test report which had been submitted by the Second Medical Laboratory was studied first by The Surgeon General's Office and then, on 18 November 1941, was forwarded to the Equipment Laboratory for its consideration.<sup>64</sup> Meanwhile, the immediate effect of the report had been to suspend all activity on Development Project, F-3, although as yet no definitive action had been taken to terminate the project formally.<sup>65</sup>

The question of resumption of development work on the mobile medical laboratory continued in abeyance until 1 April 1942. On that date, Table of Organization E-234 Medical Laboratory (Army or Communications Zone) was rewritten and the item "Laboratory, semi-trailer" deleted. In the new table, Table of Organization and Equipment 8-611 the organization of the laboratory into one stationary and three mobile sections was continued, but each mobile section was now assigned a 2½-ton cargo truck in place of the semi-trailer unit.<sup>66</sup>

The second step toward project termination was taken later in the month of April. In presenting its annual budget estimates for medical research and development for Fiscal

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Years 1943 and 1944, the Equipment Laboratory stated that no funds would be required for Development Project, F-3, unless The Surgeon General desired to have the project continued.<sup>67</sup> A similar lack of interest in continuing the experimentation was evinced by The Surgeon General's Office, and on 30 April 1942 the project was formally and officially dropped.<sup>68</sup>

#### B. The Bus-Type Laboratory.

While, as we have seen, Army Medical School and the Equipment Laboratory had a considerable amount of difficulty in reaching an agreement as to the specific items which were to be installed in the trailer laboratory, they were in complete accord on one point. Both offices felt that the new bus-type truck, then under development as a multiple ambulance, could be converted into a better medical laboratory vehicle than the semi-trailer. Unfortunately, their desire to attempt such a conversion was never gratified.

The interest of Medical Department officers in the bus-type truck as a possible substitute for the semi-trailer first became manifest in July, 1940. At that time the Equipment Laboratory wrote Army Medical School as follows:

In regard to your letter of the 5th, I am enclosing a drawing of the trailer coach that we have on order, and expect to have delivered in three or four weeks. Please return this drawing as soon as possible as it is the only copy we have. There is only one vehicle on order, but we expect to experiment with it first as a multiple ambulance, second as a unit to replace the present semi-trailers of the mobile surgical hospital, and third as a unit to contain the mobile field laboratory. This unit has many advantages -- it is constructed of tubular seamless steel, making it light and very strong and rigid; its engine is built in, so that it could not become stranded, as could a semi-trailer if someone took the tractor for another job; it is low, having a floor level only 20 inches from the ground. The unit on order has an inside height of 74 inches; this could be made greater on future vehicles, if desirable. It was bought for experimentation as a multiple ambulance, and we have thought that later we might experiment with it to replace the Army Laboratory, if desired.<sup>69</sup>

Apparently no further steps were taken in the matter until November, 1940, when the first of the front-

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drive, bus-type vehicles was delivered to Carlisle Barracks. Shortly thereafter, on 23 November 1940, The Surgeon General's Office submitted a written recommendation to The Adjutant General's Office that as soon as a sufficient number of the new low silhouette bus-type trucks could be procured, several of these be allocated to the Second Medical Laboratory for its regular use.<sup>70</sup> A few weeks later The Surgeon General's Office followed up this proposal with two more advanced requests: (1) that Table of Organization 8-235, Medical Laboratory, Army, be revised to provide for the substitution of the bus-type truck for the semi-trailer; (2) that two of these bus-type vehicles be delivered to Carlisle Barracks for installation of medical equipment, and that after this conversion they be designated as standard equipment for the Second Medical Laboratory.<sup>71</sup>

While development of the semi-trailer laboratory was continued without interruption during this period, it is evident from the data that both the Equipment Laboratory and Army Medical School were decidedly partial to the bus-type truck. In fact, problems relating to the conversion of the latter vehicle to a mobile laboratory were now being discussed in some detail.<sup>72</sup> It was soon learned, however, that the Medical Department's enthusiasm for the new type truck was not going to be given free rein. On 27 January 1941, The Adjutant General's Office replied to The Surgeon General's formal recommendations as follows:

The recommendations contained in Paragraph 3, for substitution of bus-type trucks for semi-trailers in the Medical Laboratory (Army), are not favorably considered. Adoption of the front-drive bus-type truck will be considered upon completion of the development project for this vehicle.<sup>73</sup>

Phrased as it was, the above refusal did not altogether extinguish the hope that a substitution of vehicles might be effected at some later date. Consequently, even as late as 26 February 1941, when Army Medical School was giving its final approval of the trailer laboratory, it appended this important qualifying sentence:

We will, however, state that we believe it "essential" that the final selection be a truck rather than a trailer.<sup>74</sup>

As subsequent events proved, however, the intervention of The Adjutant General's Office was, on the whole, fortunate. Field tests of the bus-type truck disclosed that it was below expectations with regard to cross-country maneuverability, and adoption of the vehicle for use with the mobile surgical hospital was not carried through.<sup>75</sup> Upon

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discontinuance of that research project, no further attempt was made by the Medical Department to obtain authorization to convert the bus-type truck into a mobile laboratory. The entire subject, therefore, turned out to be simply a distraction. As had already been pointed out, a more thorough study of all research possibilities at the start of the project might have eliminated much of this later confusion.

### C. Contributions of Phase I.

Although the research activity which was carried on during this first phase of Development Project, F-3, was underfinanced, suffered from a lack of effective coordination at the top as well as a lack of close liaison between lower-level agencies, and had been launched before a complete investigation of research alternatives had been made -- there were, nonetheless, certain definite accomplishments.

In the first place the organizational concept of a truly mobile Army Medical Laboratory was now firmly established. The latest tables of organization, despite the deletion of the semi-trailer, now specified a four-section field unit consisting of one base section and three mobile subsections. Compared to the World War I single-section laboratory, the new unit was quite a radical innovation.

Secondly, the field test of the trailer laboratory clearly demonstrated the superiority of cabinets over Medical Department chests for the storage and transportation of laboratory supplies and equipment. The Surgeon General's Office now had reliable statistics indicating the precise saving in man-hours by the use of semi-permanent cabinets and shelving.

Finally, although the particular type of vehicle which had been used in the experimentation did not prove satisfactory, the principle of self-sufficiency which it exemplified had gained genuine acceptance. The Medical Department now had convincing evidence, based on the Louisiana test maneuvers, that the concept of a mobile laboratory, completely equipped as to heating, lighting, and plumbing, was practicable for field usage.

In short, a great deal had been learned during this first development phase. All that remained was to find a sufficiently low-silhouetted and sturdy vehicle in which all of these ideas could be incorporated. This manner in which the Medical Department undertook to solve this problem is the subject of the second and concluding portion of this chapter.

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V. The Reopening of Development Project, F-3.

A. Interim Developments.

From 30 April to 2 June 1943, Development Project, F-3, remained inactive. During these thirteen months, however, steady progress was made by research and development personnel in the design and construction of certain related Medical Department vehicles. As we have seen in the preceding chapter, improvisation in the field together with extensive laboratory experimentation led, in the latter half of 1942, to the development and standardization of the first mobile surgical truck. This unit--consisting of a special medical Department van body, with appropriate interior fittings, mounted on the chassis of the standard  $2\frac{1}{2}$ -ton cargo truck--was a development of truly major importance. It provided the basic engineering pattern on which a whole series of specialized medical vehicles were subsequently constructed.

The first of these modifications of the new Truck, Surgical, was the Mobile Dental Laboratory, completed before the close of 1942 and standardized the following year.<sup>76</sup> The second, as we shall see below, was the Army Medical Laboratory.

B. Project Re-Initiation.

Upon the successful conversion of the surgical truck into a mobile dental laboratory, it was not long before a demand was made for the development, by means of a similar conversion, of an Army Medical Laboratory. On 2 June 1943 it was formally requested by the Ninth Medical Laboratory, stationed at Fort Sam Houston, Texas, that: (1) a special truck be developed for use by the Medical Laboratory, Army: (2) three such trucks be included in the Table of Equipment, Medical Laboratory, Army --- one for each mobile section. The Ninth Medical Laboratory stated that, as soon as a pilot was completed, it would be eager to test the new truck on regular field maneuvers.<sup>77</sup>

The formal project request, prepared by the Ninth Medical Laboratory, was a model of thoroughness. It brought together, for the benefit of those responsible for policy decision, the key facts, past and present, concerning the mobile medical laboratory. First, the functions of the laboratory, as set forth in the latest Army Field Manual, were given in detail:

a. General. The medical laboratory is a mobile unit designed to provide the Army medical service

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with facilities that are immediately and constantly available for laboratory examinations and investigations. It is organized into one stationary and three mobile laboratory sections.

b. Employment. Location: The stationary section is located well to the rear of the Army area where it will not become involved in minor movements and where it is readily accessible. The mobile sections are designed to be sent into corps or division areas and are especially useful in epidemiological investigations. Technical Functions: Because of the limited capacity and the location of the medical laboratory, it is not contemplated that it will engage in routine clinical examinations required by the several Army hospitals units, as these hospital units all include an organic laboratory section for this function. Its principal technical functions are associated with preventive medicine such as the examination of food and water and epidemiological investigations.<sup>78</sup>

Secondly, the present equipment of each mobile section and the loading and unloading procedures followed were described briefly. The disadvantages of both the all-purpose cargo truck and the chest-method of packing were particularly stressed. It was then pointed out that in the 1943 Louisiana Maneuvers the Tenth Medical Laboratory had used an experimental mobile field laboratory truck very successfully. The truck was a  $2\frac{1}{2}$ -ton, 6 x 6, cargo, on which removable cabinets with work benches as well as other laboratory equipment had been mounted. On the positive side, the experiment had demonstrated: (1) that laboratory operations could be performed satisfactorily in the truck; (2) that the use of cabinets for storage and transportation of equipment was far superior to the use of chests. On the negative side, the standard issue cargo truck had been found to be deficient in several respects. Since the truck did not have an enclosed body, night work under blackout conditions had been extremely difficult. Moreover, due to the lack of a heating system, laboratory efficiency could not be kept at a maximum during cold weather periods.<sup>79</sup>

On the basis of its own experience and investigation, the Ninth Medical Laboratory then proceeded to draw up a tentative list of requirements for a new mobile laboratory. These highly specific recommendations proved to be extremely valuable for they were incorporated almost without exception in the developmental model that was subsequently constructed at Carlisle. It was recommended first of all, in line with

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the findings not only of the Tenth Medical Laboratory but also of the Second Medical Laboratory on its 1941 Louisiana Maneuvers with the semi-trailer laboratory, that laboratory equipment be stored in cabinet drawers instead of chests and that an enclosed, preferably gasproof body be mounted on the selected truck chassis. Additional recommendations included: (1) lights for microscopic work, work at night, and work during the day where interior lighting was insufficient; (2) heating system to insure optimum performance in all types of weather; (3) power unit to operate lights, incubator, and refrigerator; (4) water supply with appropriate plumbing fixtures for over-all laboratory use.<sup>80</sup>

The report of the Ninth Medical Laboratory was concluded with a short discussion of three different vehicles which, with alteration, would satisfy the above requirements; the Dental Laboratory Truck (Experimental), the Surgical Truck, and the GMC Truck, 2½-ton, 6 x 6, Cargo, Supply Arm or Service Maintenance Vehicle. The advantages and disadvantages of each of these vehicles, from a conversion standpoint, were summarized briefly. Then followed the over-all recommendation that a formal development project be initiated at once to produce a mobile Army Medical Laboratory along the lines suggested.<sup>81</sup>

This thoughtful and well organized letter requesting project initiation elicited an early and favorable response from The Surgeon General's Office. On 25 June 1943, the Laboratory Branch of the Preventive Medicine Division carried the initial proposal one step further by recommending: (1) that a report be rendered by the Field Equipment Development Branch of the Plans Division as to the efficacy the 2½-ton, 6 x 6, surgical truck as a mobile laboratory unit; (2) that a temporary duty assignment of a laboratory officer from the Ground Forces, Medical Laboratories, Army, and a representative of the Laboratory Branch, Preventive Medicine Division, Surgeon General's Office, to the Medical Field Service School at Carlisle Barracks, Pennsylvania be granted when the above unit was being tested.<sup>82</sup>

Later in the same day, the Field Equipment Development Branch, Plans Division, expanded the second recommendation above by suggesting that Lieutenant Colonel C. J. Farinaeci, author of the Ninth Medical Laboratory report, be appointed as the field laboratory representative and that he and a representative of the Preventive Medicine Service be authorized not merely to witness final service tests but to coordinate the entire project with the Medical Department Equipment Laboratory and to give first-hand advice with reference to field laboratory problems.<sup>83</sup> This proposed course of action, which was subsequently approved and carried out, was extremely important. It meant, above



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all, that the Medical Department was taking decisive steps to avoid duplicating the administrative errors which had been made in Phase I of this development project. On-the-spot liaison was to be substituted for coordination by the correspondence method. Moreover, the concrete research policy which was here being established was in itself the reflection of an improved centralized control. There is little doubt that the reorganization which had recently taken place within The Surgeon General's Office was in part responsible for the change.<sup>84</sup>

On 29 June 1943, The Surgeon General's Office formally requested authorization to reopen Development Project, F-3, specifying that it desired to construct a new pilot model of the Army Medical Laboratory, using a standard  $2\frac{1}{2}$ -ton truck and installing the necessary laboratory equipment in the vehicle. Research funds in the amount of \$1,000 were requested to finance the project which was to be carried on at the Medical Department Equipment Laboratory.<sup>85</sup> Approximately one week later, Headquarters, Army Service Forces approved this request with, however, the qualification that a  $2\frac{1}{2}$ -ton, 6 x 6, truck with standard body would be used and that the laboratory equipment would be installed in such a way that it could be removed and the truck made available for other purposes when necessary.<sup>86</sup>

The Medical Department's reply to the above indorsement indicated not only that it had clearly in mind the type of truck body which was to be used in developing the medical laboratory unit and the manner in which the equipment was to be installed, but also the way in which Development Project, F-3 was to fit into an over-all program of specialized medical vehicle production. It is interesting to contrast this precise and integrated research policy with the expediential and piecemeal policy which a lack of money and personnel had forced upon the Medical Department in January, 1939.

Tentative plans for the development of subject item contemplated the use of  $2\frac{1}{2}$ -ton 6 x 6 truck chassis with the same body as that utilized for the present standard truck-surgical. Laboratory equipment will be installed within this body in a manner which will permit relatively simple removal. Thus the vehicle will not be capable of optional employment as a cargo or personnel carrier; however, it is hoped that development will be such that the same body may be used for several purposes by the substitution of different sets of removable equipment; Mobile Dental Laboratory, Mobile Optical Unit, and Mobile Medical Laboratory. It is impossible at this stage in development of

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this item to predict definitely whether this interchangeability of equipment can be attained.

It is requested that subject project be approved with the understanding that laboratory equipment will be installed on a 2½-ton 6 x 6 truck with a body of the type employed for the Truck, Surgical.<sup>87</sup>

This highly specific and forceful statement of purpose produced the desired result. On 9 July, 1943, the re-initiation of Development Project, F-3 was approved on the Medical Department's own terms by Headquarters, Army Service Forces.<sup>88</sup>

### C. The Formulation of Military Characteristics.

For some reason, not evident from the data at hand, formulation of military characteristics for the new mobile laboratory was delayed until the latter part of 1943, by which time the laboratory truck had been completed and was awaiting shipment for service test. As will be seen, however, once the processing of military characteristics had been formally initiated, all procedural steps stipulated in AR 850-25 were carefully followed. Furthermore, no difficulty was experienced in obtaining concurrences from each of the various arms and services involved.

On 22 September 1943, the Subcommittee of the Medical Department Technical Committee, acting on the recommendation of the Plans Division, of The Surgeon General's Office, proposed adoption of the following military characteristics for the Army Medical Laboratory Truck:

a. That the truck, 2½ ton, 6 x 6, Laboratory, Medical, Army be an adaptation or conversion of standard truck, 2½-ton, 6 x 6, Surgical.

b. That the equipment for installation in the truck be designed and arranged to provide for the following:

- (1) Storage space for the necessary materials for Sanitation and Health Laboratory procedures.
- (2) Adequate counter space and service facilities conveniently arranged for carrying out such procedures.
- (3) Adequate means for Laboratory Sterilization, Incubation, and Refrigeration.

c. The equipment shall be permanently installed in the truck but capable of easy removal.



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d. Size and quantity of equipment shall be held to a minimum compatible with the efficient and proper operation of a Laboratory Unit.<sup>89</sup>

Just how equipment could be "permanently installed" in a truck and yet be "capable of easy removal" was not explained. In view of the demand of Headquarters, Army Service Forces, at the time of project initiation that all laboratory equipment be readily removable, it is not unlikely that the above verbalism was consciously contrived for the occasion. If it was, it accomplished its purpose admirably. On 4 October 1943, the above statement of military characteristics was approved without modification by the Medical Department Technical Committee,<sup>90</sup> sixteen days later Army Ground Forces added its concurrence,<sup>91</sup> and, on 26 October 1943, final approval was given by Headquarters, Army Service Forces.<sup>92</sup>

## VI. Development Phase II - The Laboratory Truck.

### A. Construction Stage.

By the time all procedural details incident to the re-initiation of Development Project, F-3 had been completed, development work on the new medical laboratory was already under way. Informal authorization to begin these activities immediately had been obtained from Headquarters, Army Service Forces, on 28 June 1943,<sup>93</sup> and by 3 July 1943 the Equipment Laboratory at Carlisle had been notified to commence work on the project, and Lieutenant Colonel Farinacci, of the Ninth Medical Laboratory, had been authorized to join with the Laboratories Branch, Preventive Medicine Service, Surgeon General's Office, in furnishing professional advice on equipping the new unit.<sup>94</sup> The central direction at the policy-making level, which had been so conspicuously lacking in Phase I of this project, was now being efficiently and vigorously exercised. Moreover, as we shall see, this improved system of over-all control was to have a definite effect in bringing about an early and successful termination of the project.

On 7 July 1943, the Medical Department Equipment Laboratory forwarded to the Laboratories Branch, Surgeon General's Office, certain basic information regarding the dimensions and utility installations of the surgical van body which was to be used in the conversion, and requested that a list of the equipment desired for the laboratory be furnished as soon as possible. It was further requested that Colonel Farinacci be ordered to Carlisle for a consultation regarding cabinets, benches, and other interior fittings.<sup>95</sup>

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In its reply, the Laboratories Branch, instead of submitting a detailed equipment list, merely laid down certain general principles of selection. It was pointed out that a laboratory of the type proposed would be required to do water bacteriology and chemistry, diagnostic bacteriology and serology, gross pathology, and a limited amount of clinical pathology; these fields being listed in order of decreasing importance. It was, therefore, suggested that, pending the arrival of Colonel Farinacci, for whom travel orders had already been requested, provision be made for an incubator, water-bath, autoclave, washing facilities for glassware, and bench space for inoculation of media, use of microscopes, and similar work.<sup>96</sup>

Orders detailing Colonel Farinacci to Carlisle were dispatched from The Adjutant General's Office on 18 July 1943, and nine days later he reported to the Equipment Laboratory for temporary duty.<sup>97</sup> Farinacci, together with members of the Laboratory staff, immediately set about drawing up a list of the heavy equipment to be installed in the truck, together with certain smaller items which were in scarce supply and, on 31 July 1943, this partial list was submitted to The Surgeon General's Office with the request that these items be requisitioned direct from Washington for delivery to Carlisle. It was pointed out that the equipment would be available at a much earlier date if this method were followed instead of routing purchase action back through the Equipment Laboratory.<sup>98</sup>

Once again, it will be noted, the attempt was being made to profit from past mistakes. The slow deliveries of key equipment which had so greatly delayed completion of the semi-trailer laboratory had been due in no small part to the decentralized requisitioning procedures which had then been followed. Such delays, it was felt, could be held to a minimum by limiting Carlisle's procurement responsibility to standard and readily available laboratory supplies which could be packed into the cabinet drawers as they arrived. Meanwhile the delivery of heavy or scarce equipment could be expedited through direct procurement action by The Surgeon General's Office.

On 6 August 1943, the Laboratories Branch, Surgeon General's Office, approved the above equipment list, which had been prepared by the Equipment Laboratory, with only a few changes and additions. A one-burner gasoline stove was substituted for the two-burner unit listed, a binocular microscope was recommended instead of the monocular type, and a different type of prescription balance from the one listed was suggested. Additions included two fire extinguishers, two electric lanterns, and one Medical Department chest.<sup>99</sup>

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This modified list was thereupon approved by the Plans Division and forwarded for immediate procurement action to the Distribution Division, Surgeon General's Office.<sup>1</sup> Thus, before the middle of August, 1943, centralized procurement of key items was well under way. Meanwhile, a complete list of all other equipment both expendable and non-expendable, had been prepared by the Equipment Laboratory.<sup>2</sup> As soon as approval of these items had been secured from The Surgeon General's Office, a requisition was entered by the Medical Supply Office, Carlisle Barracks, on the Binghamton Medical Depot for delivery of all items not later than 21 August 1943.<sup>3</sup>

The selection and procurement of equipment to be installed or stored in the new laboratory was only one of the major tasks which was carried out during these early months. On 28 July 1943, the day after Colonel Farinacci's arrival at Carlisle, the Equipment Laboratory requested The Surgeon General's Office to arrange for immediate shipment of a 2½-ton, 6 x 6, surgical truck for use in the development of the proposed medical laboratory.<sup>4</sup> On 30 July 1943 the desired surgical truck was received at Carlisle from the New York Ordnance District, and, as the necessary additional materials required for construction of a pilot model had already been ordered, the job of conversion was begun at once.

The plans which had been worked out for the conversion of the surgical truck into a mobile medical laboratory did not call for any modification of the chassis of the basic vehicle. Moreover, in many respects the van body of the surgical truck needed alteration to serve its new purpose. The body was of steel and composite construction, with hard pressed structural fiber-board lining the interior. Flooring consisted of waterproof plywood covered with battleship linoleum; outside panels were of 22 gauge sheet metal supported on steel framing; and roof, side walls, and end walls were all thoroughly insulated.<sup>5</sup> All of these basic structural features, together with a number of built-in-items, could be preserved intact in the new vehicle.

However, certain changes in the design and interior construction of the van body of the surgical truck were necessary. For one thing, the amount of outside light provided by the two side windows of the basic vehicle was insufficient for daytime laboratory work, and so one more window was added on each side of the body. Similarly the single large ceiling light which had been designed chiefly for operating table use, supplemented by two small dome lights, was not a satisfactory overhead lighting arrangement for a medical laboratory. So instead, four alternating current, and two direct current dome lights were installed, together with four gooseneck sidewall lamps to furnish

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additional light for the worktables.

The plumbing was revamped also; faucets, scrub sink, and drainage pipes being moved from the extreme left front of the interior to a more accessible position near the center of the front wall.<sup>6</sup>

The redesign and spacing of the steel cabinets, drawers, and inserts was, perhaps, the most thorough-going revision of all. In the surgical truck, there had been no necessity for an extensive amount of flat worktable space, but in the new medical laboratory such facilities were essential. Consequently, instead of an irregular series of ceiling-high cabinets, a solid line of relatively low cabinets had to be built into the walls on each side of the center aisle; two long, acid-proof table tops had to be constructed to provide an unbroken working surface; and individual drawer size had to be varied so that, altogether, sufficient storage space would be available for all the many items of laboratory equipment which had been requisitioned.

Considering the difficulties, both administrative and technical, which these same problems had posed for research and development personnel during the first phase of this project, the progress which was made in the present instance was indeed remarkable. By mid-August 1943, tentative specifications for the van body of the new laboratory truck had been prepared by the Equipment Laboratory and submitted to The Surgeon General's Office.<sup>8</sup> Before the close of the same month, the actual physical conversion of the surgical truck body had been completed, construction of the new storage cabinets was nearly finished, and two-thirds of all equipment requisitioned had been received. It was anticipated that the remaining portion of the laboratory equipment would be delivered by 15 September 1943.<sup>9</sup>

The pilot model laboratory was, in fact, so nearly completed by this time that plans were made to ship the vehicle to Washington, D. C. within a week for exhibition in the War Department's public "Back The Attack" show. Actually the new vehicle, less a few minor items of equipment, was sent to Washington on 6 September 1943, remaining there as a part of the Medical Department's official display through 28 September. The unit was returned, on 29 September 1943, to the Equipment Laboratory where further work on the project was temporarily suspended pending receipt of several items of equipment which had still not been delivered. Installation of these items, it was estimated, would take only two or three days.<sup>10</sup>

Demonstration of the mobile laboratory at the Army show in Washington gave the Laboratories Branch of The

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Surgeon General's Office its first real opportunity to examine the new unit at first hand. The reaction, judging from the small number of criticisms, was quite favorable. It was merely recommended that: (1) a small pressure cooker type autoclave be substituted for the large and rather bulky autoclave which had been installed; (2) two adequate sized knee holes be provided under the bench tops so that work would be possible in a seated position; (3) consideration be given to air-conditioning the unit if practicable; (4) a small bacteriologic incubator and a hot air sterilizer be included as permanent equipment; (5) a different power unit be provided which would operate simultaneously all electrical equipment.<sup>11</sup>

The manner in which the above recommendations were made, as well as the ~~paraseology~~ of the indorsement by which they were forwarded to the Equipment Laboratory, indicated that the final decision in these matters was to be left up to the staff at Carlisle.<sup>12</sup> Making use of this discretionary authority, Laboratory officials, as we shall see in a moment, soon gave their approval to two of the above suggestions, but overruled the other three. With all differences of opinion thus exeditiously resolved, the experimental laboratory was ready for shipment to Louisiana for field tests by the close of October, 1943.

#### B. Service Testing Stage.

On 14 October 1943, the Equipment Laboratory was directed by The Surgeon General's Office to transfer the new medical laboratory truck, as soon as completed, to the Third Army, Camp Polk, Louisiana, for service test.<sup>13</sup> Last-minute changes were thereupon expedited and, in approximately two weeks time, the vehicle was turned over to the Post Quartermaster, Carlisle Barracks, for immediate shipment.<sup>14</sup> A small, 40-quart autoclave, a special hot air sterilizer, and a bacteriologic incubator had already been requisitioned, in conformance with the final recommendations of the Laboratories Branch, but had not yet been received. These items were to be forwarded individually to the Third Army as soon as they arrived.<sup>15</sup>

Meanwhile, the Laboratories Branch, was engaged in preparing an outline of basic instructions for the guidance of the officers in charge of the Louisiana field tests.<sup>16</sup> Upon completion this preliminary check list was then expanded by the Plans Division of The Surgeon General's Office into a formal Test Data Sheet,<sup>17</sup> and, by 17 November 1943, had been forwarded for appropriate action to the Commanding General of the Third Army.<sup>18</sup> Army Ground Forces, through which this correspondence was cleared, thereupon

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directed: (1) that the mobile laboratory be tested in the Louisiana Maneuver Area in accordance with the enclosed test data sheet; (2) that a preliminary report be rendered by 24 December 1943; (3) that a final test report be submitted not later than 24 January 1943.<sup>19</sup>

While everything had gone quite smoothly up to this point, a wholly unexpected setback was now encountered which delayed completion of service tests by more than two months. This delay, it would appear, was chargeable mainly to railroad personnel. The experimental mobile laboratory had been shipped to Camp Polk, Louisiana, it will be recalled, in early November. On 29 December 1943, The Surgeon General's Office was notified by Headquarters, Army Ground Forces, that the laboratory truck had not yet been received by the Third Army. A tracer was initiated immediately and, on 15 January 1944, the vehicle was finally located by the Transportation Corps. It was at the Eight Ground Ordnance Pool, Leesville, Louisiana.<sup>20</sup>

Transfer of the laboratory truck to the Third Army Maneuver Area was thereupon effected as quickly as possible. However, the three special items of equipment which had been requisitioned by the Equipment Laboratory at the request of the Laboratories Branch, Surgeon General's Office, had not yet arrived, and it was therefore decided to procure at least rough equivalents of these items locally. Considerable difficulty was encountered in locating an incubator and, as a result of this delay, it was not until the close of January, 1944, that service tests were finally begun.<sup>21</sup>

On 21 February 1944, a preliminary test report, covering the first two weeks of the maneuver period, was forwarded to The Surgeon General by the Fourth Army, which had now succeeded the Third Army as the testing agency. While the report contained a number of recommendations, it was evident that the new mobile laboratory as a whole had proven satisfactory in the testing thus far completed. The easy maneuverability of the truck, the general adequacy of supplies and equipment, and the general suitability of interior packing arrangements were especially noted. Numerous equipment additions were suggested, but these were for the most part minor. Only one change of a major character was proposed: the inclusion, as a part of non-laboratory equipment, of a 6-man pyramidal tent.<sup>22</sup> Approval of this recommendation, it will be appreciated, would result in a substantial modification of the concept of a completely self-contained laboratory vehicle. As we shall see, just such an unexpected revision was destined to be made.

The final field test report on the mobile medical laboratory was submitted by Fourth Army Headquarters on 17



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March 1944. The detailed test findings, which will be summarized briefly below, were grouped under four general headings: (1) Equipment, Glassware, Supplies, Reagents; (2) Apparatus; (3) Adaptability of the Truck as a Laboratory Vehicle; (4) Adaptability of Truck Body as a Working Area. As in the preliminary report, the general tone of the comments was highly favorable.<sup>23</sup>

With respect to equipment, glassware, supplies, and reagents, the testing agency reported that serviceability was satisfactory in comparison with equipment ordinarily used in field laboratories, and that the manner of packing provided safety in transport as well as ready accessibility for laboratory use. The original supply list of some 265 items, together with the additional equipment list proposed in the preliminary test report, were approved with only six suggested deletions, nine additions, and two quantity changes.

As for the apparatus which had been installed in the laboratory, this was described as generally satisfactory. The two-burner gasoline stove, the water bath, and the electric centrifuge were specifically mentioned as being valuable, and the aluminum cooker was listed as a very useful adjunct to the field autoclave. The hot air sterilizer and the air-jacket incubator which had been provided were found, however, to be too small for the uses intended, additional generators were suggested for the Coleman burners, and a kerosine-operated refrigerator was recommended in place of the electric refrigerator which had been furnished.

The earlier request that a tent be added to the list of non-laboratory equipment was here repeated, although the idea of using a pyramidal tent for this purpose had now been discarded.

A tent is necessary to supplement the truck for the collecting and recording of specimens, autoclaving and possible sterilizing of equipment. For convenience of operation, protection against inclement weather, and blackout condition, it would be most suitable to use a surgical operating tent of the type used in Armored Divisions so that direct attachment to the rear of the truck would be possible.<sup>24</sup>

As we shall see, before long the idea of a single-vehicle, self-contained medical laboratory had been expanded into a truck-trailer combination that was considerably more elaborate than anything that had been visualized at the start of Development Project, F-3.

As for the adaptability of the 2½-ton, 6 x 6, truck

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as a field laboratory vehicle, Fourth Army officials were highly enthusiastic. Excellent maneuverability with only negligible equipment damage, despite frequent changes of location, made the truck an ideal vehicle for field laboratory use, the testing agency reported. The adaptability of the truck body as a working area was equally praised. The size of the truck, its design, head room, and aisle space were all found to be adequate. Two technicians and one assistant, it was stated, could be accommodated without confusion. Moreover, interior facilities, with a few minor exceptions, had proved to be entirely satisfactory from an operational standpoint.

On 14 April 1944, the above test report was forwarded for study and reply to the Laboratories Branch, Surgeon General's Office,<sup>25</sup> and three weeks later that office presented its detailed comments.<sup>26</sup> The changes in small laboratory items which had been recommended by Fourth Army officials were for the most part approved. The idea of adding a surgical operating tent to equipment lists was approved. Disagreement was voiced mainly with respect to proposed changes in heavy equipment and interior construction. The Laboratories Division concluded its remarks with the following:

On the basis of this report the truck is considered essentially satisfactory. The changes recommended are not serious enough to lead to a belief that the idea is other than sound. It is, therefore, recommended that these changes be discussed and plans made to standardize the truck as soon as agreement can be reached on the details.<sup>27</sup>

The above letter, together with copies of the preliminary and final test reports, was forwarded within a few days to the Equipment Laboratory at Carlisle Barracks for its comments and recommendations.<sup>28</sup> Then, on 23 May 1944, a conference was held at The Surgeon General's Office in Washington with representatives of the Laboratories Division, the Technical Division, and the Equipment Laboratory attending. The mobile medical laboratory, which had been returned by the Fourth Army and was now on display at a second Army War Show, was carefully inspected and agreement was reached regarding the changes which would be made incident to its standardization.<sup>29</sup> On 29 May 1944, revised specifications, drawings and equipment lists covering the conference suggestions were prepared by the Equipment Laboratory and forwarded to The Surgeon General. The second paragraph of the accompanying letter of transmittal indicated the extent to which research and development personnel had been influenced by the recommendations of the testing agency.<sup>30</sup>



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Attention is invited to the fact that the equipment list (Inclosure 2) does not cover the following items which, it is understood, will be made part of the Table of Equipment.

Tent, Surgical Truck, Operating      ea 1  
(Complete with poles & pins)

Power Unit, PE 75-T      ea 1

Trailer, Cargo, 1-ton      ea 1

In short, approval of the additional supply items recommended by Fourth Army officers, together with inclusion of the surgical tent, had now forced inclusion of a two-wheel trailer to transport this overflow equipment. The mobile medical laboratory, it may be observed, had had a remarkably fertile incubation period.

Photographs of the completed laboratory truck, as it was presented for final standardization (see Figures 25 and 26), appear on the pages immediately following.

## VII. Standardization and Procurement.

### A. Standardization Phase.

As early as 30 December 1943, three months before final service test results had reached The Surgeon General's Office, certain key standardization data had already been assembled by the Plans Division. A formal nomenclature had been prepared for the new item, and the following tentative basis of issue, covering Medical Department installations only, had been drawn up: (a) 3 Laboratory Trucks for each Army or Communications Zone Laboratory; (b) 2 Laboratory Trucks for each General Laboratory. Using these unit allotments as a yardstick, total Medical Department requirements for 1944 were estimated at 60 trucks.<sup>31</sup>

On 17 February 1944, in answer to Medical Department request, Army Air Forces submitted a preliminary estimate of the number of medical laboratory vehicles it would need during the current year. Employing a rather complicated basis of issue, involving ten different classifications of Air Force installations, a total requirement for 45 trucks was arrived at.<sup>32</sup> Compared with the estimated needs of the Medical Department, which would presumably be the principal user of the new mobile laboratory, Air Corps demands appeared to be somewhat inflated. Significantly, this initial figure of 45 was pared down substantially by the Medical Department Technical Committee. On 25 March 1944, Army Ground Forces informed The Surgeon General that it had no need for the new laboratory truck, and with the receipt of this information,<sup>33</sup> the preliminary investigation of

anticipated requirements was ended.

Once final field test reports had been received and a conference held regarding last-minute modifications of the laboratory truck, formal action was initiated within The Surgeon General's Office to process the new item for standardization. The necessary forms were prepared by the Technical Division during the early part of June, 1944, and on 6 June the Medical Department Technical Subcommittee met to consider the question in detail. Highlights of this meeting were: (1) approval of the addition to equipment lists of a PE-75 Generator (Signal Corps item), a Surgical Operating Tent (Quartermaster item), and a 1-ton, 2-wheel cargo trailer (Ordnance item); (2) reduction of Army Air Force bulk allotment of the new trucks from 45 to 10; (3) approval of the 103 trucks as the total quantity requirement for 1944, with 34 additional vehicles scheduled for 1945.<sup>34</sup>

On 12 June 1944, Subcommittee recommendations were approved without substantial change by the Medical Department Technical Committee,<sup>35</sup> and on 4 July 1944 request for standardization of the mobile medical laboratory received the official approval of Headquarters, Army Service Forces.<sup>36</sup>

#### B. Procurement Phase.

In view of the relatively expeditious manner in which project initiation, development and testing and processing for standardization had been carried out in this second phase of Development Project, F-3, it would appear that a disproportionate amount of time was required to get the new laboratory truck into quantity production. In part the delay was caused by an unexpected reversal of action on the part of Army Service Forces. On 4 July 1944, as we have seen, Headquarters, Army Service Forces had approved the request of The Surgeon General's Office for standardization of the medical laboratory truck. This action had explicitly included approval of the proposed bulk allotment of 10 vehicles for Army Air Forces.<sup>37</sup> More than a month later, however, a revision of the above basic of issue was suddenly demanded.

On 11 August 1944, in a memorandum to the Director of Material, Army Service Forces, the Director of Supply, Army Service Forces, requested that the bulk allotment of 10 laboratory trucks to Army Air Forces, previously approved by that Headquarters, now be rescinded for the following reasons:

These Medical Department items cannot be construed as possessing characteristics



peculiar to the Army Air Forces . . . .

The above approved basis of issue precludes accurate computations of authorized allowances for overseas commands.

The above approved basis of issue does not provide basic data essential in computing requirements for the Army Supply Program.<sup>38</sup>

It was thereupon recommended that the bulk allotment for Army Air Forces be translated into organizational requirements.

If the above were cogent reasons in August, 1944 for establishing an organizational basis of distribution for the Air Corps, it is difficult to perceive why they were not equally cogent in July, 1944. In any event, in view of the excellent coordination that had been maintained by the Medical Department up to this point, the delay was conspicuous. It was not one, moreover, which could be directly chargeable to The Surgeon General's Office.

The carrying out of the requested revision consumed an additional month's time. The Army Service Forces' communication was forwarded routinely through channels, and it was not until 31 August 1944 that a translation of bulk allotment into organizational requirements had been made by the Deputy Air Surgeon, Army Air Forces. The amended basis of issue called for the authorization of one each of the medical laboratory trucks, in pertinent Tables of Organization and Equipment, to the following Air Forces Headquarters: 5th, 8th, 10th, 11th, 12th, 13th, 14th, and 15th.<sup>39</sup> The Air Forces "translation" was approved by The Surgeon General's Office on 6 September 1944,<sup>40</sup> and no further objections appear to have been raised by Headquarters, Army Service Forces.

Arriving at a more satisfactory basis of issue for the new mobile laboratory was not the only difficulty that beset research and development personnel during this final period. Obtaining a suitable purchase description for the new refrigerator which was to be installed in the truck took several weeks,<sup>41</sup> and the drawing up of final specifications for the truck body and interior were not completed until nearly the beginning of September.<sup>42</sup> By this time, with the Allied armies moving rapidly across France, the original allotment of laboratory trucks to the European Theater was deemed excessive. Accordingly, in the Army Service Forces production schedule for the last quarter of 1944, total quantity requirements for the new mobile medical laboratory were reduced from 103 to 83.<sup>43</sup>

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On 28 September 1944, a production order for 83 medical laboratory trucks was placed by Army Medical Purchasing Office in New York City. Chassis and van body were procured through the Ordnance Department, with the Medical Department supervising the installation of interior fittings.<sup>44</sup> Exact cost figures are not available, but the estimated unit cost for this quantity production was \$5500.<sup>45</sup> On 18 October 1944, six vehicles were cancelled from the original order, leaving a total of 77 to be manufactured. By 20 December 1944, 37 of these had been delivered, and within another 30 days the remaining 40 had been received. No further production orders were placed for the medical laboratory truck.<sup>46</sup>

The allocation of the new mobile laboratory, by theaters of operation, is presented in the table below.<sup>47</sup>

AUTHORIZATION BY THEATERS OF OPERATION  
26 October 1944

<u>Theater</u>	<u>No. by 31 Dec. 1944</u>	<u>No. by 31 Dec. 1945</u>
Pacific Ocean Area	5	5
North Africa	13	13
China-Burma-India	5	5
South Pacific Base Command	3	3
European Theater	13	19
Southwest Pacific Area	24	24

C. Project Termination.

Before the close of September, 1944, the Equipment Laboratory at Carlisle, having completed all last-minute revisions of specifications and drawings, recommended to The Surgeon General that Development Project, F-3 be dropped from its list of active projects.<sup>48</sup> Termination of the project was accordingly authorized by The Surgeon General's Office on 3 October 1944,<sup>49</sup> and a few weeks later arrangements were made to dispose of the pilot model laboratory truck by shipping it where it would be more urgently needed.<sup>50</sup>

It had taken exactly 11 years, 5 months, and 20 days to develop, standardize, and procure a new Army Medical Laboratory.

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## VIII. Conclusion.

### A. Physical Evaluation.

The mobile Army medical laboratory, in the form in which it was finally standardized, represented the best features of all models which had preceded, both regulation and experimental. The new laboratory truck, with its Ordnance chassis and special Medical Department van body, was at least as sturdy, commodious, and maneuverable as the all-purpose cargo truck which had been in standard use as a medical laboratory vehicle since World War I. It was vastly superior, on all counts, to any of the trailers or semi-trailers which had been experimented with during the thirties and early forties.

In interior construction, the new van body truck was a radical departure from the open-body cargo vehicle which, until 1944, had been the standard item for rear-zone laboratory units. Within the enclosed body were specially designed, built-in storage cabinets; complete plumbing, heating, and lighting facilities; adequate work bench installations and ample aisle space. Five windows provided additional natural light and ventilation. In short, all the structural innovations of the 1939 semi-trailer laboratory had been incorporated in the new model, with added improvements.

Finally, by the addition of a surgical operating tent and a small 2-wheel trailer to carry this and other overflow equipment, the operational advantages of all earlier laboratory models were combined in a single assembly. The inclusion of a 1-ton trailer in the new unit made it possible to transport as much as had previously been possible with the cargo type of vehicle. The inclusion of a surgical operating tent made possible actual field operation of a portion of the laboratory. Such tasks as specimen-collecting, record-keeping, and, when necessary, sterilization of glassware could thus be conducted out of doors, under tentage, while precise and exacting laboratory procedures could be carried out in the interior of the truck. None of the previous laboratory models had possessed this dual flexibility.

### B. Administrative Aspects.

While the administration of research and development activities during the first phase of Development Project, F-3 was on a relatively low plane of efficiency, a marked improvement in administrative performance took place during Phase II of this undertaking. The procedural requirements of AR 850-25 were not only adhered to more closely during

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this latter period, but the time required for such processing action was greatly reduced. Centralized policy control and firm over-all coordination at the top were substituted for the loose decentralization and jurisdictional overlapping that had characterized the earlier phase. On-the-spot liaison took the place of consultation by correspondence. Central procurement of key items of equipment was instituted as an expediting measure and the purchase of routine items was facilitated by definitely discouraging last-minute modification of equipment lists.

It is interesting to note that this sudden improvement in project administration coincided, in point of time, with a major reorganization within The Surgeon General's Office. In March, 1942, the Planning and Training Division, which had previously been charged with the over-all control of medical research and development, was abolished. In its stead the Operations Service was organized, and to one of its divisions, the Plans Division, was given the specific responsibility of developing new medical field equipment.<sup>51</sup> Again, in February, 1944, a further reorganization took place. The Technical Division was established within the Operations Service, and to it was delegated not only the responsibility for the conduct and/or supervision of an expanding amount of medical research and development, but the coordination of all types of research activity, including the writing of specifications and the preparation of Tables of Organization and Equipment.<sup>52</sup>

A careful examination of the documents with which this study has been concerned suggests that these changes in organization, leading to a greater centralization and integration of research and development activities, were to a considerable degree responsible for the administrative improvement that was shown during the second phase of this project.

### C. The Time Factor.

While, as we have seen, the new Army Medical Laboratory was generally conceded to have been an excellent end-product, it had quite obviously been developed too late to be of very extensive service in World War II. Quantity deliveries of the new unit to overseas installations did not begin until December, 1944. Since the war in Europe was over by May of 1945 and the Pacific war by August of that year, it is evident that on-the-spot improvisations had had to suffice for more than three years of the fighting.

Yet Development Project, F-3 had been established as early as April, 1933. Why had it taken the Medical

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Department more than eleven years to produce a satisfactory mobile medical laboratory?

It is, of course, evident from the discussion which has preceded that the duration of Development Project, F-3 was definitely protracted by administrative and procedural delays. Numerous instances of these types of delay have been pointed out in the course of this narrative. Not all, of course, were chargeable to the Medical Department. Other agencies had participated in the undertaking, and each bore some measure of responsibility for the total time which had been lost through these causes.

The importance of this factor, however, should not be exaggerated. Even considered in the aggregate, the total time lost as a result of administrative and procedural delays was simply a matter of months, while what we are chiefly concerned with here is an explanation that will encompass years. A more satisfactory explanation, therefore, would seem to be along the following lines.

From 1933 to 1939, medical research and development was critically handicapped by a lack of adequate operating funds. In Fiscal Year 1934, for example, no funds whatever were available for the development of medical field equipment. In 1935 and 1936, only \$1,500 and \$2,500, respectively, were appropriated.<sup>53</sup> Clearly, no modern military establishment, however well administered, could have conducted an effective and comprehensive program of medical research and development on such a budget. Furthermore, from January, 1939 to January, 1942, while research activity was increased somewhat, limited funds still narrowed the field of research possibilities to such an extent that only surplus military vehicles could be earmarked for experimentation. What should have been creative engineering, therefore, was actually little more than diligent tinkering.

It is true that the administration of this project could have been improved. It should be emphasized, however, that for nearly nine of the eleven years of its existence Development Project, F-3 was either completely inactive or seriously hamstrung because of a simple lack of money.

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FOOTNOTES TO CHAPTER VI

- <sup>1</sup>Ltr. to A.G.O., fr. S.G.O., 24 Jan. 1939; subject: "Army Medical Laboratory" (M.D.E.L.).
- <sup>2</sup>Table of Organization 286-W, Medical Laboratory (Army or Communications Zone), 31 Aug. 1921.
- <sup>3</sup>See n. 1, above.
- <sup>4</sup>Memo. to N. Y. Medical Supply Depot, fr. Capt. C. V. Morgan, 12 Nov. 1937, Par. 10 (M.D.E.L.).
- <sup>5</sup>Medical Department Research Program, Fiscal Year 1941, 3 Apr. 1941, CONFIDENTIAL, p. 33-34 (Rec. Rm., S.G.O. 700.2-1). Extracted in clear.
- <sup>6</sup>Ibid., p. 33.
- <sup>7</sup>Ibid., p. 34.
- <sup>8</sup>Table of Organization 286-W, Medical Laboratory (Army or Communications Zone), 23 Feb. 1927.
- <sup>9</sup>See n. 5, above.
- <sup>10</sup>Notes on Pennsylvania State Board of Health Mobile Medical Laboratory, Jun., 1934 (M.D.E.L.).
- <sup>11</sup>See n. 5, above.
- <sup>12</sup>See n. 1, above.
- <sup>13</sup>Ibid.
- <sup>14</sup>Ibid.
- <sup>15</sup>Ibid.
- <sup>16</sup>3rd Ind. to M.D.E.L., fr. S.G.O., 7 Feb. 1939; basic: see n. 1, above, (M.D.E.L.).
- <sup>17</sup>Ltr. to T.S.G., fr. Research Coordination Br., Plans Div., S.G.O., 12 Oct. 1943, SECRET; subject: "Monthly Status Report on Research and Development Projects for the month of September" (Hist. Div., S.G.O.). Extracted in clear.
- <sup>18</sup>See n. 5, above.
- <sup>19</sup>Supra, p. 358.

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<sup>20</sup>See n. 5, p.

<sup>21</sup>Infra, pp. 3381-3382.

<sup>22</sup>Annual Report for Fiscal Year 1945, Research Coordination Br., Technical Div. (Hist. Div., S.G.O.).

<sup>23</sup>3rd Ind. to A.G.O., fr. S.G.O., 27 Jan. 1941; basic: not on file (M.D.E.L.).

<sup>24</sup>Ltr. to A.M.C., fr. M.D.E.L., 2 Feb. 1939; subject: "Mobile Laboratory" (M.D.E.L.).

<sup>25</sup>Ltr. to Holabird QM Depot, fr. M.D.E.L., 25 Apr. 1939; subject: "Installations at Holabird QM Depot in Army Mobile Medical Laboratory Semi-trailer Body" (M.D.E.L.).

<sup>26</sup>Ibid.

<sup>27</sup>1st Ind. to Holabird QM Depot, fr. M.D.E.L., 23 May 1939; basic: ltr. to M.D.E.L., fr. Holabird QM Depot, 20 May 1939; subject: "EDT Project 25-9-Semi-trailer 2-wheel, 2dt-Medical Laboratory" (M.D.E.L.).

<sup>28</sup>Ltr. to American Hard Rubber Co., fr. M.D.E.L., 5 Mar. 1939 (M.D.E.L.). Also see memo. to M.D.E.L., fr. Dept. of Sanitation, M.F.S.S., 28 Mar. 1940 (M.D.E.L.).

<sup>29</sup>Ltr. to M.D.E.L., fr. American Hard Rubber Co., 11 Mar. 1940 (M.D.E.L.).

<sup>30</sup>Ltr. to M.D.E.L., fr. Monsanto Chemical Co., 14 Mar 1940 (M.D.E.L.).

<sup>31</sup>Office memo., "Ebony Finishes", undated (M.D.E.L.).

<sup>32</sup>Ltr. to M.D.E.L., fr. B. F. Goodrich Co., 2 Jul. 1940; subject: "Acid Seal Paint. 1945" (M.D.E.L.).

<sup>33</sup>Ltr. to Coleman Lamp & Stove Co., fr. M.D.E.L., 4 Feb. 1939; subject: "Stove" (M.D.E.L.).

Ltr. to American Machine Gas Co., fr. M.D.E.L., 4 Feb. 1939; subject: "Stoves" (M.D.E.L.).

<sup>34</sup>Ltr. to M.D.E.L., fr. Holabird QM Depot, 29 Mar. 1940; subject: "Project EDT 25.9, Semi Trailer 2-wheel, 2dt" (M.D.E.L.).

<sup>35</sup>Ltr. to S.G.O., fr. M.D.E.L., 3 Sep. 1940; subject: "Army Mobile Laboratory" (M.D.E.L.).

<sup>36</sup>Ibid.

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- <sup>37</sup>Ltr. to A.M.C., fr. M.D.E.L., 9 Jul. 1940 (M.D.E.L.).
- <sup>38</sup>Memo. to M.D.E.L., fr. A.M.C., 5 Aug. 1940 (M.D.E.L.).
- <sup>39</sup>See n. 35, p. 398.
- <sup>40</sup>Ltr. to M.D.E.L., fr. S.G.O., 23 Aug. 1940; subject: "Ambulance busses and mobile Army medical laboratory" (A.M.R. & D. Bd.).
- <sup>41</sup>See n. 35, p. 398.
- <sup>42</sup>Ibid.
- <sup>43</sup>Ltr. to S.G.O., fr. A.M.C., 18 Sep. 1940; subject: "A Supply List for Laboratory Trailer Truck" (A.M.R. & D. Bd.).
- <sup>44</sup>1st Ind. to M.D.E.L., fr. Plans & Training Div., S.G.O., 19 Sep. 1940; basic: see n. 43, above (A.M.R. & D. Bd.).
- <sup>45</sup>Ltr. to M.D.E.L., fr. A.M.C., 25 Sep. 1940 (M.D.E.L.).
- <sup>46</sup>Ltr. to A.M.C., fr. M.D.E.L., 20 Nov. 1940 (M.D.E.L.).
- <sup>47</sup>Ltr. to M.D.E.L., fr. A.M.C., 6 Dec. 1940 (M.D.E.L.).
- <sup>48</sup>Ltr. to S.G.O., fr. M.D.E.L., 9 Dec. 1940; subject: "Army Mobile Medical Laboratory" (M.D.E.L.).
- <sup>49</sup>2d Ind. to A.M.C., fr. S.G.O., 17 Dec. 1940; basic: see n. 48, above (M.D.E.L.).
- <sup>50</sup>3rd Ind. to S.G.O., fr. A.M.C., 20 Dec. 1940; basic: see n. 48, above (M.D.E.L.). Note especially Incl. 1.
- <sup>51</sup>4th Ind. to M.D.E.L., fr. S.G.O., 27 Dec 1940; basic: see n. 48, above (M.D.E.L.).
- <sup>52</sup>Ltr. to A.M.C., fr. M.D.E.L., 21 Jan. 1941 (M.D.E.L.).
- <sup>53</sup>1st Ind. to M.D.E.L., fr. A.M.C., 28 Jan. 1941; basic: see n. 52, above (M.D.E.L.).
- <sup>54</sup>Ltr. to S.G.O., fr. 2d Medical Lab., Ft. Sam Houston, Tex., 7 Jan. 1941; subject: "Laboratory Trailer" (A.M.R. & D. Bd.).
- <sup>55</sup>3rd Ind. to 2d Medical Lab., Ft. Sam Houston, Tex., fr. S.G.O., 8 Mar. 1941; basic: see n. 54, above (A.M.R. & D. Bd.).
- <sup>56</sup>Ltr. to A.M.C., fr. S.G.O., 3 Apr. 1941; subject: "Equipment for Mobile Laboratory" (M.D.E.L.).



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- 57 1st Ind. to S.G.O., fr. A.M.C., 15 Apr. 1941; basic:  
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- 58 Ltr. to S.G.O., fr. M.D.E.L., 25 Apr. 1941; subject:  
"Road Test Laboratory, Semi-trailer" (M.D.E.L.). For  
text of this report, see Appendix E.
- 59 Ibid.
- 60 6th Ind. to M.D.E.L., fr. 1324th Service Unit, Office of  
the QM, Carlisle Bks., Pa., 2 Jul. 1941; basic: ltr. to  
S.G.O., fr. M.D.E.L., 29 Apr. 1941; subject: "Army  
Mobile Field Laboratory No. 1" (A.M.R. & D. Bd.).
- 61 Ltr. to 2d Medical Lab., Lake Charles, La., fr. S.G.O.,  
16 Aug. 1941; subject: "Mobile Laboratory, Trailer"  
(A.M.R. & D. Bd.).
- 62 Report on the Experimental Mobile Laboratory Trailer, Hq.,  
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(M.D.E.L.). For text of this report see Appendix F.
- 63 Ibid.
- 64 2d Ind. to M.D.E.L., fr. S.G.O., 18 Nov. 1941; basic:  
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- 65 Monthly Progress Reports, M.D.E.L., covering the period 1  
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- 66 Table of Organization & Equipment 8-611, Medical Laboratory,  
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- 67 Monthly Progress Report, M.D.E.L., Apr., 1942 (A.M.R. & D.  
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- 68 Ltr. to C.G., A.S.F., fr. Plans Div., S.G.O., 29 Jun.  
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- 69 Ltr. to A.M.C., fr. M.D.E.L., 9 Jul. 1940 (M.D.E.L.).
- 70 Ltr. to A.G.O., fr. S.G.O., 23 Nov. 1940; subject:  
"Improved type of Vehicles for Medical Department Special  
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- 71 Ltr. to T.A.G., fr. S.G.O., 30 Nov. 1940; subject:  
"Transport for 2d Medical Laboratory (Army) - (M.D.E.L.).
- 72 Ltr. to A.M.C., fr. M.D.E.L., 6 Jan. 1941 (M.D.E.L.).  
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- <sup>73</sup>3rd Ind. to S.G.O., fr. A.G.O., 27 Jan. 1941; basic: see n. 71, p. 400 (M.D.E.L.).
- <sup>74</sup>Ltr. to M.D.E.L., fr. A.M.C., 26 Feb. 1941 (M.D.E.L.).
- <sup>75</sup>Memo. to Asst. Chf. of Staff, G-4, fr. S.G.O., 22 Dec. 1941 (Hist. Div., S.G.O.).
- <sup>76</sup>See Chapter VII.
- <sup>77</sup>Ltr. to S.G.O., fr. Hq., 9th Medical Lab., Ft. Sam Houston, Tex., 2 Jun. 1943; subject: "Special Vehicle for Mobile Section of Medical Laboratory, Army" (A.M.R. & D. Bd.).
- <sup>78</sup>Excerpt fr. Par. 170, FM 8-10, Medical Service of Field Units, 28 Mar. 1942. Cited in ltr. referred to in n. 77, above.
- <sup>79</sup>See n. 77, above.
- <sup>80</sup>Ibid.
- <sup>81</sup>Ibid.
- <sup>82</sup>Memo. to Field Equipment Development Br., Plans Div., S.G.O., fr. Laboratory Br., Preventive Medicine Service, S.G.O., 25 Jun. 1943 (A.M.R. & D. Bd.).
- <sup>83</sup>Memo. to Chf., Research Coordination Br., Plans Div., S.G.O., fr. Chf., Field Equipment Development Br., Plans Div., S.G.O., 25 Jun. 1943; subject: "Research Project for the Medical Laboratory, Army" (A.M.R. & D. Bd.).
- <sup>84</sup>Monograph by Chf., Research Coordination Br., Technical Div., S.G.O., History of World War No. II, fr. 1 Jan. 1939 to 30 Jun. 1944, SECRET, Tab. 15 (Hist. Div., S.G.O.).  
Extracted in clear.
- <sup>85</sup>Ltr. to C.G., A.S.F., (Attention: Chf., Development Br., Requirements Div.), fr. S.G.O., 29 Jun. 1943; subject: "Laboratory, Medical, Mobile, Army - development project on" (A.M.R. & D. Bd.).
- <sup>86</sup>1st Ind. to S.G.O., fr. Hq., A.S.F., 5 Jul. 1943; basic: see n. 85, above (A.M.R. & D. Bd.).
- <sup>87</sup>2d Ind. to C.G., A.S.F., fr. S.G.O., 6 Jul. 1943; basic: n. 85, above (A.M.R. & D. Bd.).
- <sup>88</sup>3rd Ind. to S.G.O., fr. Hq., A.S.F., 9 Jul. 1943; basic: see n. 85, above (A.M.R. & D. Bd.).

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- 89 Ltr. to M.D.T.C., fr. Subcommittee on Field Equipment, 22 Sep. 1943; subject: "Truck, 2½-Ton, 6x6, Laboratory, Medical, Army" (A.M.R. & D. Bd.).
- 90 Min. of M.D.T.C., Meeting No. 10, held 4 Oct. 1943, RESTRICTED (Hist. Div., S.G.O.). Extracted in clear.
- 91 2d Ind. to C.G., A.S.F., fr. Hq., A.G.F., 21 Oct. 1943; basic: see n. 89, above (A.M.R. & D. Bd.).
- 92 3rd Ind. to S.G.O., fr. Hq., A.S.F., 26 Oct. 1943; basic: see n. 89, above (A.M.R. & D. Bd.).
- 93 See notation on memo. to Chf., Research Coordination Br., Plans Div., S.G.O., fr. Chf., Field Equipment Br., Plans Div., 25 Jun. 1943; subject: "Research Project for Revision of the Medical Laboratory, Army" (A.M.R. & D. Bd.).
- 94 Memo. to M.D.E.L., fr. S.G.O., 3 Jul. 1943; subject: "Laboratory, Medical, Mobile"; with incls. (A.M.R. & D. Bd.).
- 95 Ltr. to S.G.O., fr. M.D.E.L., 7 Jul. 1943; subject: "Mobile Medical Laboratory" (M.D.E.L.).
- 96 1st Ind. to M.D.E.L., fr. S.G.O., 17 Jul. 1943; basic: see n. 95, above (M.D.E.L.).
- 97 Monthly Narrative Report, M.D.E.L., 1 - 31 Jul. 1943 (A.M.R. & D. Bd.).
- 98 Ltr. to S.G.O., fr. M.D.E.L., 31 Jul. 1943; subject: "Equipment for Mobile Medical Laboratory" (M.D.E.L.).
- 99 Memo. to Chf., Operations Service, S.G.O., fr. Laboratory Br., Preventive Medicine Service, S.G.O., 6 Aug. 1943; subject: "Equipment for Mobile Medicine Laboratory, Project F-2.01" (A.M.R. & D. Bd.).
- 1 1st Memo. Ind. to Distribution Div., S.G.O., fr. Plans Div., S.G.O., 7 Aug. 1943; basic: see n. 99, above (A.M.R. & D. Bd.).
- 2 Monthly Narrative Report, M.D.E.L., 1 - 31 Jul. 1943 (A.M.R. & D. Bd.).
- 3 Requisition MD 36-004-21-44 to CO. Binghamton Medical Depot, fr. Medical Supply Office, Carlisle Bks., Pa., 6 Aug. 1943 (M.D.E.L.).
- 4 Ltr. to S.G.O., fr. M.D.E.L., 28 Jul. 1943; subject: "Mobile Medical Laboratory" (M.D.E.L.).

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- <sup>5</sup>U. S. Army Tentative Specification AXS-981, Body, Surgical Van,  $2\frac{1}{2}$  Ton Armored Force, 14 Jul. 1943.
- <sup>6</sup>Compare M.D.E.L. Photo No. S-309: Also see Monthly Narrative Report, M.D.E.L., 1 - 31 Aug. 1943 (M.D.E.L.).
- <sup>7</sup>Ibid.
- <sup>8</sup>M.D.E.L. Tentative Specification No. 53-B, Van Body  $2\frac{1}{2}$ -Ton, Medical Corps, M-1 (Laboratory Truck), 7 Aug. 1943 (Supply Service, S.G.O.).
- <sup>9</sup>Monthly Narrative Report, M.D.E.L., 1 - 31 Aug. 1943 (A.M.R. & D. Bd.).
- <sup>10</sup>Monthly Narrative Report, M.D.E.L., 1 - 30 Sep. 1943 (A.M.R. & D. Bd.).
- <sup>11</sup>Memo. to Operations Div., S.G.O., fr. Laboratories Br., Preventive Medicine Service, S.G.O., 5 Oct. 1943; subject: "Experimental Mobile Laboratory Truck" (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).
- <sup>12</sup>Ibid. See also 1st Ind. to M.D.E.L., fr. S.G.O., 9 Oct. 1943; basic: see n. 11, above (Rec. Rm., S.G.O. 451.2-1 Carlisle Bks.-N).
- <sup>13</sup>Ltr. to M.D.E.L., fr. S.G.O., 14 Oct. 1943; subject: Transfer of Truck,  $2\frac{1}{2}$  Ton, 6x6, Laboratory, Medical, Army" (A.M.T. & D. Bd.).
- <sup>14</sup>3rd Ind. to S.G.O., fr. M.D.E.L., 2 Nov. 1943; basic: see n. 13, above (A.M.R. & D. Bd.).
- <sup>15</sup>Monthly Narrative Report, M.D.E.L., 1 - 30 Nov. 1943 (A.M.R. & D. Bd.).
- <sup>16</sup>Memo. to Plans Div., Operations Service, fr. Laboratories Div., Preventive Medicine Service, 11 Nov. 1943; subject: "Truck,  $2\frac{1}{2}$  Ton, 6x6, Laboratory, Medical, Army" (A.M.R. & D. Bd.).
- <sup>17</sup>Memo. to C.G., Third Army, fr. S.G.O., 17 Nov. 1943; subject: "Truck,  $2\frac{1}{2}$  ton, 6x6, Laboratory, Medical, Army". Incl. 1, Test Data Sheet. (A.M.R. & D. Bd.).
- <sup>18</sup>See n. 17, above.
- <sup>19</sup>2d Ind. to C.G., Third Army, Ft. Sam Houston, Texas, fr. Hq., A.G.F., 29 Nov. 1943; basic: see n. 17, above (A.M.R. & D. Bd.).

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- 20 Memo. for Record. 30 Dec. 1943, initialed by Lt. Col. John B. Klopp, Dir., Technical Div., S.G.O.: Subject: "Shipment of Laboratory truck" (A.M.R. & D. Bd.).
- 21 Preliminary Test Report, Truck, 2½ Ton, Laboratory, Medical, Army, for the period 30 Jan. to 12 Feb. 1944, inclusive; Incl. 3 of 4th Ind. to C.G., Fourth Army, fr. Fourth Army, D.r Hq., 15 Feb. 1944; basic: see n. 17, p. (A.M.R. & D. Bd.).
- 22 Ibid.
- 23 Final Test Report, Truck, 2½ Ton, 6x6, Laboratory, Medical, Army, 17 Mar. 1944; Incl. 5 of 6th Ind. to C.G., Hq., Fourth Army, Ft. Sam Houston, Texas, fr. Dir. Hq., Louisiana Maneuver Area, 18 Mar. 1944; basic: see n. 17, p. (A.M.R. & D. Bd.). For complete text of this report see Appendix G.
- 24 Ibid., p. 5.
- 25 Transmittal Sheet to Chf., Laboratories Div., fr. Dir., Technical Div., 14 Apr. 1944; subject: "Final Test Report, Truck, 2½ Ton, 6x6 Laboratory, Medical, Army" (A.M.R. & D. Bd.).
- 26 Memo. to Technical Div., fr. Laboratories Div., 9 May 1944 (M.D.E.L.).
- 27 Ibid.
- 28 Ltr. to M.D.E.L., fr. S.G.O., 11 May 1944; subject: "Truck, 2½ Ton, 6x6, Laboratory, Medical, Army" (A.M.R. & D. Bd.).
- 29 Monthly Narrative Report, M.D.E.L., 1 - 31 May 1944 (A.M.R. & D. Bd.).
- 30 Ltr. to S.G.O., fr. M.D.E.L., 29 May 1944; subject: "Truck, 2½-ton, 6x6, Medical Laboratory" (A.M.R. & D. Bd.).
- 31 Ltr. to Distribution & Requirements Div., S.G.O., fr. Plans Div., S.G.O., 30 Dec. 1943; subject: "Surgical Truck, Laboratory, Army or CZ" (A.M.R. & D. Bd.).
- 32 5th Ind. to S.G.O., fr. Hq., A.A.F., 17 Feb. 1944; basic: ltr. to The Surgeon, Hq., A.A.F. School of Applied Tactics, Orlando, Fla., fr. Hq., A.A.F., 13 Sep. 1944; subject: "Mobile Trailer Laboratory Unit" (A.M.R. & D. Bd.).
- 33 2d Ind. to C.G., A.S.F., fr. Hq. A.G.F., 25 Mar. 1944;

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basic: ltr. to S.G.O., fr. Hq. 4th Army, 21 Feb. 1944;  
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34 Ltr. to M.D.T.C., fr. Medical Dept. Technical Subcommittee,  
6 Jun. 1944, CONFIDENTIAL; subject: "Medical Department  
Technical Subcommittee Report on: Truck, 2½ Ton, 6x6,  
Laboratory, Medical" (A.M.R. & D. Bd.). Extracted in  
clear.

35 Min. of M.D.T.C. Meeting held 12 Jun. 1944, RESTRICTED  
(Hist. Div., S.G.O.). Extracted in clear.

36 2d Ind. to S.G.O., fr. Hq., A.S.F., 4 Jul. 1944; basic:  
ltr. to C.G., A.S.F., fr. S.G.O., 21 Jun. 1944; subject:  
"Truck, 2½ Ton, 6x6, Laboratory, Medical" (A.M.R. & D. Bd.).

37 Ibid.

38 Memo. to Dir. of Materiel, A.S.F., fr. Dir. of Supply, Hq.,  
A.S.F., 11 Aug. 1944, CONFIDENTIAL; subject: "Basic of  
Issue for Truck, 2½ Ton, 6x6, Dental Operating and Truck,  
2½ Ton, 6x6, Laboratory, Medical" (Rec. Rm., S.G.O.  
451.2). Extracted in clear.

39 2d Memo. Ind. to C.G., A.S.F., fr. Deputy Air Surgeon, Hq.,  
A.A.F., 31 Aug. 1944; basic: see n. 38, above (Rec. Rm.,  
S.G.O. 451.2). Extracted in clear.

40 4th Ind. to C.G., A.S.F., fr. Chf., Operations Service,  
S.G.O., 6 Sep. 1944, CONFIDENTIAL; basic: see n. 38  
above (Rec. Rm., S.G.O. 451.2). Extracted in clear.

41 Memo. to Development Br., S.G.O., fr. Chf., Supply  
Coordination Br., S.G.O., 23 Sep. 1944; subject: "Item  
9948300, Refrigerator, Mechanical, 2 Cubic Ft., 110  
Volt, 60 Cycle" (A.M.R. & D. Bd.).

42 Ltr. to Development Br. S.G.O., fr. Chf., Supply  
Coordination Br., S.G.O., 30 Aug. 1944; subject: "Item  
9958720 - Truck, 2½ Ton, 6x6, Laboratory, Medical -  
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43 Ltr. to C.G., A.S.F., fr. S.G.O., 8 Sep. 1944,  
CONFIDENTIAL; Truck, 2½ Ton, 6x6, Laboratory, Medical"  
(A.M.R. & D. Bd.). Extracted in clear.

44 1st Ind. to Hist. Div., S.G.O., fr. A.M.P.O., N.Y.C., 31  
Oct. 1945; basic: ltr to A.M.P.O., fr. Historical Div.,  
S.G.O., 22 Oct. 1945 (Hist. Div., S.G.O.).

45 See n. 34, above.

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<sup>46</sup>See n. 44, p. 405.

<sup>47</sup>Ltr. to C.G., P.O.A; C.G., NATOUSA; C.G., CBI; C?G., So. Pac. Base Comd.; C.G., ETO; C.G., S.W.P.A., fr. Chf., Supply Service, S.G.O., all dated 26 Oct. 1944, g CONFIDENTIAL; subject: "Medical Department Trucks" (Rec. Rm., S.G.O. 451.2.). Extracted in clear.

<sup>48</sup>Monthly Narrative Report, M.D.E.L., 1 - 30 Sep. 1944  
(A.M.R. & D. Bd.).

<sup>49</sup>Memo. to Dir., M.D.E.L., fr. Chf., Operations Service, S.G.O., 3 Oct. 1944; subject: "Development Projects - Termination of" (A.M.T. & D. Bd.).

<sup>50</sup>Memo. to Chf., Supply Service, S.G.O., fr. Dir., Technical Div., S.G.O., 28 Oct. 1944; subject: "Mobile Units - Disposal of" (A.M.R. & D. Bd.).

<sup>51</sup>Annual Report, Service of Supply, for Fiscal Year ending 30 Jun. 1942, pp. 56-57 (Hist. Div., S.G.O.).

<sup>52</sup>Monograph by Chf., Research Coordination Br., Technical Div., S.G.O., History of World War No. II, fr. 1 Jan. 1939 to 30 Jun. 1944, SECRET, (Hist Div., S.G.O.). Extracted in clear.

<sup>53</sup>Army Medical Bulletin, No. 32, Jul., 1935, p. 75.

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## CHAPTER VII

### THE MOBILE DENTAL LABORATORY

#### I. Introduction.

##### A. The World War I Dental Laboratory.

In World War I dental prosthetic service was furnished to forward elements of the American Expeditionary Forces by what were described as "portable dental laboratories."<sup>1</sup> The integral equipment of each of these laboratories consisted of one Medical Department chest, weighing slightly more than 200 pounds when fully packed, in which was contained all the items deemed essential for the manufacture and repair of bridges and dentures. This chest, too heavy to be hand carried, was in itself something of a field problem as no specific transportation was then provided for divisional dental units. In moving from one area to another, the officer in charge of the laboratory was obliged to plead for cargo space in whatever unpre-empted vehicle he could locate.

The results of this awkward transportation arrangement, which was typical of divisional dental operating as well as dental laboratory units, were not altogether happy, as is indicated in the following passage from the Annual Report of The Surgeon General for Fiscal Year 1919.

The transportation of dental equipment and supplies has ever been a source of irritation to division commanders, transportation officers and division surgeons. . . . Much loss of equipment and consequent loss of dental service in several divisions has resulted thereby. The First Division, moving into combat area in May, 1918, was forced to abandon their entire dental equipment through lack of transportation facilities. . . . At that time it required the entire resources of our Medical Supply Depot No. 3 to resupply emergency equipment for this division after its arrival in the new area.<sup>2</sup>

Lack of assigned transportation, however, was not the only weakness of the portable dental laboratory. No table of organization had been established for the unit and, as a consequence, it possessed no permanently assigned personnel. Although typically the laboratory staff consisted of one dental officer and one enlisted dental mechanic, the amount of time that could

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be devoted to the making of dental replacements, as well as the quality of the personnel assigned to these tasks, depended upon the military situation and the total number of dental officers and technicians assigned to a given command. Inasmuch as there was a shortage of over 300 dental officers even at the time of the signing of the armistice, it is evident that dental laboratory service, especially in the division area, was subject to considerable fluctuation throughout the war.<sup>3</sup>

Since no separate tentage had been provided, the laboratory had to be housed with other units. Usually it was located with one of the division field hospitals.<sup>4</sup> This arrangement, desirable perhaps from a personnel standpoint, nevertheless had its drawbacks. Chiefly, it limited the mobility of the portable laboratory, transforming it into a virtually semi-fixed installation. Troops in adjacent areas could not be served on the spot, thereby necessitating, for those soldiers requiring prosthetic service, separation from their respective units while they travelled to the nearest field hospital. The individual soldier was thus likely to be unavailable for purely military duties for a matter of days rather than hours. Obviously, where the units concerned were scheduled to move back into combat within a short time, such separations required immediate replacements. Under these conditions it would not be surprising if the individual need for bridges or dentures did not always receive the promptest attention.

Finally, there was the question of the adequacy of the prosthetic equipment which had been provided for the laboratory. Actual combat usage had disclosed deficiencies in all types of dental equipment and, with the conclusion of the war, steps were taken by the Medical Department to re-examine all of these items with a view toward developing more satisfactory units for future use.

In order to take advantage of the vast fund of experience gained during this campaign a board of three experienced dental officers was selected for consideration of modifying dental equipment and supplies to meet actual field conditions. The report of this board has been forwarded to the medical equipment board. Their recommendations will greatly modify dental equipment and reduce to a minimum the size and number of containers for the articles deemed necessary.<sup>5</sup>

These words had a confident ring. As prophecy, however, they were not altogether accurate.

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B. The Modified Portable Dental Laboratory. ✓

Although the board of dental officers appointed by War Department orders in October, 1919, did revise existing dental supply tables considerably,<sup>6</sup> and although in 1921 three new field dental units (Individual, Dispensary, and Hospital Company) were developed and standardized,<sup>7</sup> it was apparently nearly ten years before the portable dental laboratory underwent basic modification. By that time the earlier aim of the Dental Division to reduce the weight and bulk of all field items and to reduce the number of packing containers had evidently passed into discard. In comparison with the World War I model, the new dental laboratory was heavier, virtually as bulky, and required two containers instead of one.<sup>8</sup>

Developed by the Medical Department Equipment Laboratory in the early thirties, the new portable dental laboratory unit was contained in two standard size, reinforced chests (Medical Department Chest #61, and Medical Department Chest #62). These chests were provided with special inserts for the packing of prosthetic equipment and supplies. While individually each of the two chests, when fully packed, was somewhat lighter than the single laboratory container used during the first world war, gross weight of the complete unit was in excess of that of the earlier model. As for equipment, with the exception of one hand lathe all dental supplies and machinery were standard Class 5 items. Concededly, in terms of the amount and variety of equipment provided, the new unit was an improvement over the World War I assembly.

Upon approval by the Medical Department Technical Board, the new laboratory chests, together with their respective equipment lists, were officially appended to the Tables of Basic Allowance for the Medical Battalion, the Medical Regiment, and the Evacuation Hospital. It was visualized apparently that upon the return of a division to its rest area, selected battalion and regimental dental personnel would then take over and operate a dental laboratory service. Prosthetic service at evacuation hospitals, on the other hand, was evidently for the benefit of those units in the division area which were too small to have their own attached dental personnel.

While in some respects it had been a definite step forward to have the new laboratory unit included in standard supply tables, thus remedying one of the major defects of World War I practice, the wisdom of assigning responsibility for dental prosthetic service to divisional medical units was open to considerable question. For one thing, these heavy laboratory chests would seldom, if ever, be opened in actual combat zones, for the circumstances of combat would rarely permit this service to function. In all probability, when

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a given medical unit went into action its dental laboratory equipment would simply be left behind at the division dump in its rest area. Moreover, where battle lines were fluid, it would often be difficult to relocate, claim, and obtain this equipment for prompt use when the unit had withdrawn to some new bivouac point.

There was, however, a further and even more serious weakness in the arrangement. Even assuming the return of the division to its original rest area, or the prompt receipt of its prosthetic equipment from a previous rest area, it was highly dubious if division dental personnel, just returned from active duty in the combat zone, would still possess sufficient physical energy and zeal to set up and maintain an effective field laboratory service. Rather it would seem reasonable to presume that dental officers and technicians would require just as adequate rest periods as other officers and men of a division. Emphatic criticism of this double duty aspect of field prosthetic service was made, it will be noted, by the Dental Division of The Surgeon General's Office at the outset of World War II.

As for the equipment of the new laboratory, though it did represent a decided advance over World War I facilities, numerous deficiencies were noted as the years passed. Instead of an electric lathe the laboratory had been supplied with a substitute standard hand lathe. This enforced dependence upon manual power for the polishing of dental replacements was a serious handicap involving considerable loss of time. It was estimated that on a busy day the full time of two enlisted men and several others, operating in relays, would be required to provide the necessary power. As a further complication, there was no stable element in the entire assembly to which the hand lathe could be attached.

Other laboratory supply items were also subsequently found to be unsatisfactory. The alcohol and kerosene burners which had been furnished had no protection against drafts and thus functioned at lowered efficiency a good portion of the time. The special type blowpipe provided could not be used effectively with the existing facilities. The casting machine was not equipped with a stable mounting and for that reason could not function in the field. Finally, the quantity of supplies was discovered to be insufficient for performance of the services contemplated.

As we shall see in a moment, by 1941 all of the above criticisms, along with several others, were being levelled against the Modified Portable Dental Laboratory. The Medical Department had improved on the World War I laboratory. The improvement, however, had not gone far enough.

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## II. Initiation of Development Project, F-24.

### A. Proposal of the Project.

An unsuccessful attempt to obtain research funds for the development of a more modern type of field dental laboratory was made by the Dental Division of The Surgeon General's Office in May, 1939.<sup>9</sup> On 11 September 1941, however, the same request was reintroduced--this time with happier results. In this second petition to The Surgeon General, the Director of the Dental Division began by restating the primary aims of the field dental laboratory service. The merits of the old portable laboratory were then carefully weighed in the light of these objectives. Needless to say, by the time this examination had been concluded, an impressive case had been presented against the then standard field dental laboratory.<sup>10</sup>

To begin with, it was pointed out that approximately one-half of one per cent of division personnel, when leaving the combat zone, required dental service involving the use of laboratory facilities. Unless, therefore, such services were available at the rest area or town in which a division was bivouacked, from 75 to 100 officers and enlisted men would have to be detached from their units for an indefinite period of time. To prevent this waste of manpower, field dental laboratories, capable of moving quickly to any designated bivouac point and establishing station without delay, were essential. Such flexibility of movement, however, presupposed a high degree of operational self-sufficiency. Measured by those standards, the old portable laboratory was sadly deficient in several respects.

In the first place, its stock of equipment was so inadequate that the laboratory could no longer meet ordinary demands for prosthetic service. Yet if this defect were remedied, inclusion of the laboratory in corps and division organization tables would not be practicable. The quantity of prosthetic supplies and equipment necessary in the light of modern developments in dental service and present day Army requirements would constitute far too great a burden for forward units to transport.

In the second place, packing arrangements were unsatisfactory. Medical Department chests or other types of separate locker boxes or containers, while entirely adequate for the temporary reception of instruments or supplies, could be only too readily removed from the transporting vehicle. This was especially true where, as in the present case, the operating unit did not

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possess its own integral transportation. It was also pointed out that in moving the laboratory from one station to another considerable loss of time was involved in packing and unpacking equipment stored in laboratory chests.

Finally, attention was called to the present lack of permanently assigned personnel. No specially trained staff, assigned to the laboratory to perform prosthetic construction alone, had been provided. Instead, each laboratory was forced to depend upon regular divisional dental personnel for its day-to-day operation. The inefficiency of this arrangement, as well as the unfairness of its double duty aspects, both from the standpoint of the dental officers and technicians and their soldier patients, was commented upon at some length.

The possible alternatives to the present portable laboratory, the Dental Division continued, were mainly three in number. First, there was the fixed type of dental laboratory installation located in a forward sector of the Army zone in the vicinity of the rest areas. The disadvantages of this alternative were clearly overriding. Corps and division personnel would be required to leave their units in order to obtain necessary prosthetic attention. Moreover, the demands of other units stationed in the Army zone for this type of service would invariably mean that the needs of the field force could not be adequately met.

There remained the alternative of developing some type of mobile unit, so staffed and equipped that it could operate independently of all other units for considerable periods of time. In this category there were two possibilities: a two-vehicle trailer laboratory or a single-vehicle motorized laboratory. The former, it was pointed out, possessed certain serious disadvantages. For one thing, the trailer type of conveyance with its separate power truck unit was much less maneuverable in the traffic congestion of a Theater of Operations than a single, self-contained vehicle. Even more important, however, was the unavoidable danger which lay in the fact that the power unit was so readily detachable from its trailer. In short, other authority in the Theater could easily appropriate the prime mover for its own use, and, once this had been done, the trailer laboratory was left completely immobilized.

In the opinion of the Dental Division, therefore, future field dental laboratories should be installed in power-contained motorized vehicles. The appropriation of such specialized units for other purposes would be much less likely, and yet all of the advantages of the trailer type laboratory would be preserved. Dental supplies could be stored within the body of the vehicle and prosthetic equipment requiring a stable mounting could be properly bolted into place upon



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permanent bases, thereby greatly increasing operational efficiency and materially reducing the amount of time customarily consumed in packing and unpacking. With the enclosed interior of the truck affording ample protection against inclement weather and draft currents, casting, soldering, and vulcanizing procedures could now be efficiently conducted at any time, whereas out in the open, under tentage, or in open trucks such operations were often difficult in the extreme, if not impossible.

Having stated its case for the development of a new mobile laboratory along the lines suggested, the Dental Division concluded its memorandum to The Surgeon General with the following concrete recommendations:

It is recommended that a new motorized field dental laboratory be developed, similar to the field medical laboratory.

It is further recommended that a dental laboratory section be added to the Medical Service (Army) as a part of the medical laboratory unit. The dental laboratory section to consist of four motorized field dental laboratories; also that provision be made in the Tables of Organization, Medical, for a mobile field dental laboratory and the necessary personnel therefor, same to be determined by a board of officers to consider this plan.

In line with its second recommendation, the Dental Division appended to its report, as Annex No. 1, a suggested list of essential laboratory equipment and a tentative personnel table.<sup>12</sup>

#### B. Processing the Proposal.

In the above project proposal the Dental Division had not explicitly stated that the new laboratory should be provided with cabinets and shelving, instead of laboratory chests, for the storage of all loose equipment and supplies. It had, however, recommended that the Army medical laboratory, which was equipped with storage cabinets, be taken as a model, and it had emphatically stated that the use of Medical Department chests or any other type of separate packing containers for storage or transporting purposes had been found to be highly unsatisfactory and justifiable only on the grounds of temporary expediency. It might also be observed, parenthetically, that during this same month, September, 1941, the superiority of the cabinet over the chest method of packing was being vividly demonstrated in the Louisiana field tests of the mobile medical laboratory.<sup>13</sup>

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However, in forwarding the recommendations of the Dental Division through channels, one of the officers of the Plans and Training Division, while approving initiation of the project, inserted a request that the old Dental Laboratory Chests #61 and #62 be retained.<sup>14</sup> Favorable action on this proviso might well have set back development work materially, for it was not until October, 1942, with the standardization of the Surgical Truck, that a formal precedent existed for the substitution of cabinets for chests in mobile medical units.<sup>15</sup> Moreover, without the additional storage space which cabinets and shelving would provide, it is difficult to see how the limited facilities of the old portable dental laboratory could have been properly expanded, as the Dental Division had strongly advocated, by the inclusion of a substantially more complete and modern line of prosthetic equipment and supplies.

Fortunately for the future course of the project, the above recommendation for retention of the laboratory chests as standard packing equipment was over-ruled by the Chief of the Plans and Training Division. The latter, in a memorandum dated 17 September 1941 and addressed to the Executive Officer of The Surgeon General's Office, expressed himself unequivocally on the matter.

It is believed that the dental equipment in Chests #61 and #62 is of questionable value to field units in that for a large part of the time in a theater it constitutes just so much excess baggage to be carried around with the unit. Furthermore its value is in many instances curtailed due to inadequate facilities (shelter, etc.) for setting up the equipment and suitable for its proper function.

It is believed, however, if the Chests #61 and #62 are eliminated, a readjustment of dental personnel is indicated. The personnel now available to use these chests in the unit should be reduced if and when the chests are no longer issued and the functions and work contemplated are furnished by this mobile army dental laboratory.<sup>16</sup>

The above memorandum appears to have ended the controversy. All reference to the chests was omitted from the tentative outline of military characteristics for the new laboratory, prepared by the Medical Department Technical Subcommittee on 12 November 1941,<sup>17</sup> and this action was subsequently sustained by higher authority. A year later, on 3 November 1942, Medical Department Chests #61 and #62 were formally deleted from the Tables of Basic Allowance of all medical regiments and medical battalions.<sup>18</sup>

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With this problem settled, no further disagreements arose to delay the formal processing of the project proposal. The successive steps which were next taken, moreover, were in complete conformance with the procedural requirements of AR 850-25. On 17 November 1941, the Medical Department Technical Committee approved without modification the report of its Subcommittee, which included the following recommendations:

- a. That a research project be established to develop a Mobile Dental Laboratory.
- b. That the following military characteristics for the subject project to be approved.
  1. Dental Laboratory to be permanently installed in a motor vehicle adopted as standard by the Army.
  2. This unit to be as small as possible, consistent with adequate space and necessary equipment and working space.
  3. The equipment apparatus installed to be held to the absolute minimum for the proper and appropriate function of such a unit, all equipment to be permanently installed.<sup>19</sup>

It will be noted that paragraph "b.1." above stated that the new laboratory was to be installed in a motor vehicle "adopted as standard by the Army." This provision had, and was to continue to have, a rather interesting history. During the late summer of 1941, the Dental Division had undertaken to discover for itself a vehicle which would be suitable for conversion into a mobile dental laboratory. First, blueprints of a model designed by the Ritter Dental Manufacturing Company of Rochester, New York, were examined. These were, however, considered too elaborate.<sup>20</sup>

Inquiry was then made of the Office of the Chief of Ordnance regarding the type of chassis and body currently being used for Ordnance Technical Trucks.<sup>21</sup> Ordnance replied on 29 August 1941 that its technical trucks were 1½-3 ton, 4x4 models, consisting of a bus-type body manufactured by Wayne Works Incorporated, and a standard Quartermaster chassis manufactured by General Motors Corporation. Specifications and photographs of the vehicle were inclosed. The cost of the truck, it was stated, was approximately \$2,200.<sup>22</sup>

The Dental Division was favorably impressed, especially since there was already some evidence that these vehicles could be used for field dental laboratories. On file in The Surgeon General's Office were photographs, taken in 1939, which showed similar machine shop trucks in which shapers, drill presses, and arbor presses had been provisionally installed.<sup>23</sup> While this unit had never been standardized, visually

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it seemed quite promising. Accordingly, in its formal report to The Surgeon General requesting project initiation, frequent reference was made by the Dental Division to the suitability of the Ordnance Shop truck as a dental laboratory vehicle.<sup>24</sup>

While these actions on the part of the Dental Division were, in a sense, something of an invasion of purely research and development territory, no serious complications resulted. The Chief of the Plans and Operations Division in forwarding the recommendations of the Dental Division, suggested a considerably more general statement of vehicle specifications,<sup>25</sup> and in the final formulation of military characteristics by the Medical Department Technical Subcommittee,<sup>26</sup> this provision was so liberally phrased that research and development personnel found no difficulty in substituting a completely different type of Ordnance truck, both chassis and body, when the occasion arose.

Returning now to the administrative processing of Development Project, F-24, on 18 November 1941, initiation data was forwarded by The Surgeon General's Office to The Adjutant General, with the following requests: (1) that the Medical Department be authorized to establish a formal project to develop a mobile dental laboratory; (2) that the proposed military characteristics be approved; (3) that \$3,000 be allocated from current research funds to the Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania, for carrying on the necessary development work.<sup>27</sup>

On 27 November 1941, approval of the above requests was granted by The Adjutant General.<sup>28</sup> The Equipment Laboratory was promptly notified of this action and by December 1941, preliminary development activity was well under way.<sup>29</sup>

### III. Development Phase.

#### A. Construction of the Laboratory.

Because of the extensive investigation and experimentation which had already been conducted by Equipment Laboratory personnel in connection with the Mobile Surgical Hospital, the Army Medical Laboratory, and the Armored Force Surgical Truck, and because of the data which had been collected by the Dental Division regarding Ordnance Technical Trucks, there was little need in the present instance for any elaborate study of research possibilities. Bus-type, trailer, and semi-trailer laboratories had already been carefully examined, service tested, and found impracticable for overseas use. Thus the choice of a suitable dental laboratory vehicle had been automatically narrowed to: (1) the 1½-3 ton, 4x4, Ordnance Technical Truck, recommended

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by the Dental Division, and (2) the 2½ ton, 6x6, cargo truck, with special van body, which had been used in the development of a surgical truck for the Armored Forces.

While the pilot model of the new surgical truck had not yet been completed, it is evident that the Equipment Laboratory was already thinking seriously of using some modification of this vehicle instead of the Ordnance Technical Truck, for the mobile dental laboratory project. On 8 December 1941, Lieutenant Colonel Neal A. Harper, a dental corps officer stationed at Carlisle Barracks, wrote as follows to the Chief of the Dental Division in Washington, regarding a recent conference he had had with the staff at the Equipment Laboratory.

With regard to the mobile field dental laboratories, I have had conversations with Colonel Dabney and his engineer, Mr. Taylor. Both of these gentlemen are anxious that I withhold any plans until the arrival of a mobile surgical unit expected in about a week.<sup>30</sup>

The definite selection, so far as the Equipment Laboratory was concerned, of the 2½-ton, 6x6, van body truck as the vehicle to be used in the current experimentation appears to have been made within a month after the above date, for in the early part of January consultation was held with members of the dental staff of the Medical Field Service School and with the Post Dental Surgeon at Carlisle Barracks regarding the design and arrangement of interior equipment to be installed in this van body truck.<sup>31</sup> A tentative blueprint, based upon the interior dimensions of the multiple purpose van body, was then prepared and on 13 January 1942 was submitted to the Post Dental Surgeon, who thereupon forwarded the design to the Chief of the Dental Division, Office of The Surgeon General for comment.<sup>32</sup>

If, at this point, the Dental Division had any reservations regarding the suitability of the vehicle selected, it does not appear to have made that fact known. As far as can be ascertained from the data at hand, no correspondence passed between the Dental Division and the Equipment Laboratory from the middle of January to the middle of March, 1942. Finally, on 18 March 1942, complete drawings and specifications of the new mobile dental unit were forwarded by the Equipment Laboratory to The Surgeon General with the request that negotiations be opened as soon as possible for the purchase of a pilot model.<sup>33</sup>

This latter request apparently injected the proper note of urgency into the proceedings. On 20 April 1942, the Dental Division returned the preliminary plans data with instructions that the Equipment Laboratory make certain minor

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changes. No reference was made to the 4x4 technical truck which that office had previously recommended.<sup>34</sup> Drawings and specifications were quickly revised by the Laboratory to meet the objections stated, and three days later were resubmitted for final approval.<sup>35</sup>

During the months of May, June, and July, no further action was taken by the Equipment Laboratory on Development Project, F-24.<sup>36</sup> While there is some indication that an effort was made by The Surgeon General's Office in the latter part of April, 1942, to have a pilot model dental laboratory custom built by the Holabird Quartermaster Depot,<sup>37</sup> no such vehicle was produced. It was not, in fact, until August, 1942, that a suitable experimental model was obtained and the necessary conversion work initiated.

This three-month delay in beginning actual development work would seem to be attributable largely to two factors, neither of which reflected upon either the technical or administrative efficiency of Medical Department personnel. The first factor was that civilian as well as military facilities for vehicle production were being taxed to the utmost with war orders. As we have already seen in Chapter V, the possibility of placing a single-unit experimental order at this particular time was virtually out of the question.

Because of this production bottleneck, the second factor--the "A" priority of the Armored Force surgical truck project--assumed an almost overriding importance. The efforts of the Equipment Laboratory and The Surgeon General's Office simply had to be concentrated on the procurement of a pilot model surgical truck, for which there was a demand of the most urgent nature. Even with this concerted pressure, it should be observed, it was not until 18 July 1942 that this experimental truck was delivered to Carlisle Barracks.<sup>38</sup>

Since cabinets had already been installed in the surgical truck at the factory, all that remained to be done on this project was to pack in the necessary equipment, which was all on hand, and ship the vehicle to Fort Knox, Kentucky for an accelerated service test. Inasmuch as, in view of the urgency of the matter, only a brief field test was contemplated, an early return of the surgical truck to Carlisle Barracks was expected. Needless to say, the possibilities which this situation opened up for Development Project, F-24, now hopelessly stalled for lack of an experimental vehicle, were not lost on research and development personnel.

On 3 August 1942, the Director of the Medical Department Equipment Laboratory, wrote as follows to The Surgeon General's Office:

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2. The Equipment Laboratory has on hand the pilot model of the Mobile Surgical Truck of which twenty-four (24) additional units are under procurement for the armored force. The chassis and body of this truck is identical with the vehicle intended for use as a Mobile Dental Laboratory.

3. By installing the necessary cabinets and interior equipment as indicated on Equipment Laboratory Specification No. 60 (Interior Equipment for Medical Department Dental Laboratory, Mobile), this Surgical Truck can be converted to a pilot model Mobile Dental Laboratory. This work can be done in the Equipment Laboratory shops. Funds for procurement of materials are available under Project F-24, Mobile Dental Laboratory.

4. Recommendations: Unless the pilot model Surgical Truck now at the Equipment Laboratory is to be consigned to a field organization for use as a Surgical Truck, authority is requested to convert it into a pilot model Mobile Dental Laboratory.<sup>39</sup>

This requested authority was granted by The Surgeon General's Office on 5 August 1942.<sup>40</sup> As the surgical truck had not yet been field tested, it was still necessary to wait several weeks before beginning the job of actual conversion, but by the end of August the pilot model had been returned from Fort Knox, Kentucky, and dismantling operations were soon begun. Conversion of the truck to a mobile dental laboratory was not, however, an altogether simple matter.

An extra window had to be cut on each side of the truck, and a suitably sized window assembly, complete with blackout curtains, installed in the rear of the body. The following pieces of equipment had to be removed from the interior of the truck: all cabinets, (including sink cabinet), fire extinguisher, 5-gallon water tank, center operating light, and parcel racks (to be reinstated later). Complete rewiring to suit the new lighting arrangements was necessary; wheel housings had to be cut down in front and rear in order to accommodate the new chair storage compartments. Piping between the 50-gallon and 5-gallon tanks, and to the sink faucets, had also to be changed to conform to the new drawings.<sup>41</sup>

Before conversion work could get fully under way, the additional window assemblies which were needed for the laboratory had to be obtained. These were ordered at an early date from Krieger Steel Sections, Incorporated, Long Island City, New York, a firm already busily engaged in war work.<sup>42</sup> Apparently this relatively small order did not receive a great deal of attention, for it was December before

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the window assemblies were finally delivered.<sup>43</sup> This was but one instance of a type of delay which deferred completion of the pilot model dental laboratory until February, 1943. So far as the task of physical conversion was concerned, according to Equipment Laboratory estimates, all shop work on the vehicle could have been finished before the close of September.<sup>44</sup> The remaining months were, therefore, spent largely in marking time--waiting for the arrival of interior equipment and supplies that had been requisitioned as early as July and August of 1942.

The procurement difficulties of Development Project, F-24--and these were the only serious stumbling blocks encountered in the construction stage--can be traced back to the spring of 1942. On 23 April 1942, the day when the Equipment Laboratory had resubmitted its revised drawings and specifications of the proposed laboratory vehicle, it explicitly requested that the Dental Division of The Surgeon General's Office requisition at the earliest possible moment all supplies and equipment to be installed in the truck and have these items shipped direct to the Equipment Laboratory at Carlisle.<sup>45</sup> This request for central procurement had been made because the Medical Department Equipment Laboratory, a Class 4 installation, had in the past experienced extremely serious delays in obtaining requisitioned equipment for its experimental models. As we have seen in Chapter VI, decentralized procurement had become one of the most time-consuming aspects of the research and development process.

It was soon obvious, however, that the mere transfer of procurement responsibility from a Class 4 installation to headquarters of the technical service concerned was no guarantee in itself that a conspicuously more efficient job would be done. Despite the Equipment Laboratory's urgent request for action, it was nearly three months before a detailed equipment list had been prepared by the Dental Division and submitted for clearance purposes to the Finance and Supply Division of The Surgeon General's Office.<sup>46</sup> It was not, moreover, until 28 July 1942 that the purchase order for this material (Surgeon General's Office Requisition #91508) had formally entered supply channels.<sup>47</sup> As might have been anticipated, the processing of this requisition by the medical depots was painfully slow. After months of waiting, telegrams were sent by the Equipment Laboratory both to the Savannah, Georgia and the Binghamton, New York supply depots, in an attempt to expedite delivery of the equipment items still unreceived. The answers were almost identical: "Shipment will be made as soon as stock becomes available."<sup>48</sup>

The new window assemblies for the laboratory truck were finally delivered by Krieger Steel Sections, Incorporated, in the early part of December, 1942. Conversion work was then resumed and, by 29 December, 1942, body construction had been

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completed and all equipment on hand had been installed.<sup>49</sup> The transformation of the surgical truck into a mobile dental laboratory was now almost an accomplished fact. The interior equipment of the surgical truck had been torn out, wheel housings had been cut down, additional window openings had been made, and the new Krieger frames mounted into position. The laboratory had been completely rewired, plumbing connections altered, and water heating and air circulating units installed. Specially designed storage cabinets had been moved in and their table top coverings fitted into place. The sink cabinet, the parcel rack, and the 50-gallon water tank had been reinstalled in their new positions against the forward wall. Bracket clamps and shields had been inserted for the flexible side wall lamps, and overhead lights, widely spaced, had been fastened into position on the ceiling of the truck.<sup>50</sup>

With the exception of a casting machine and lathe, which had not yet arrived, the dental laboratory was now completed. Early in January, 1943, a representative of the Dental Division, Office of The Surgeon General, visited Carlisle Barracks and inspected the new pilot model. He was advised at that time by Equipment Laboratory personnel that the above items had not been received, and was requested to aid in expediting their delivery.<sup>51</sup> It was, however, another thirty days before the needed equipment items were obtained. After that, completion of the laboratory was only a matter of hours, and, on 8 February 1943, The Surgeon General was formally notified that the pilot model mobile dental laboratory was ready for shipment.<sup>52</sup>

#### B. Testing Phase.

The pilot model mobile dental laboratory was driven to Washington, D.C. in the early part of February, 1943, and was formally presented to the Medical Department by the Gold and Platinum Metals in Dentistry at a short ceremony held at The Surgeon General's Office.<sup>53</sup> This manufacturers association had donated some eight thousand dollars for the dental laboratory program.<sup>54</sup> Unfortunately this generous gift, which had been placed in escrow with the Treasury Department in November, 1942,<sup>55</sup> had not been available in time to materially expedite the project. This public spirited action by the Gold and Platinum Metals in Dentistry, however, pointed the way to a new type of industrial-military cooperation. Timely donations of money or, within the limits of priority regulations, needed supplies, equipment, or rolling stock, could greatly accelerate the process of wartime research and development. Certainly much precious time could have been saved in the subject instance if such outside collaboration had been available from the start.

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After a preliminary inspection, the dental laboratory unit was returned to Carlisle Barracks and, on 12 February 1943, The Surgeon General's Office requested Army Ground Forces to make arrangements for a service test of the new vehicle at the earliest practicable date.<sup>56</sup> This urgent proposal, unfortunately, was not translated into action for nearly four weeks. By 6 March 1943, the basic communication had just reached Army War College which advised that the Dental Surgeon, Second Army, was familiar with the laboratory in question and would accordingly be requested to select the particular Second Army unit to conduct the test.<sup>57</sup>

On 16 March 1943, Headquarters, Second Army, Memphis, Tennessee, replied that the First Convalescent Hospital, scheduled to arrive at the Tennessee maneuver area on 21 April 1943, would be designated as the testing agency for the new laboratory.<sup>58</sup> By 3 April 1943, this information was on its way from The Surgeon General's Office to the Medical Department Equipment Laboratory.<sup>59</sup> On 8 April 1943--two months to the day since the completion of the dental laboratory--the pilot model was shipped to Camp Forest, Tennessee, for service test.<sup>60</sup> Another month elapsed and then actual field testing was finally begun.

From 16 May to 19 June, 1943, the pilot model mobile dental laboratory was given intensive operational tests throughout the Tennessee Maneuver Area by the First Convalescent Hospital. Differing types of troop units were served for periods ranging from three to ten days; changes of location were frequent, and the tests included operations under blackout conditions. During this four week period, laboratory personnel completed thirty-five full dentures, one hundred and fourteen partial dentures, and thirteen repair cases. Immediately upon completion of the service tests, a detailed report of findings was prepared by the testing agency. This was forwarded to The Surgeon, Second Army, on 22 June 1943.<sup>61</sup>

The field test report submitted by the First Convalescent Hospital was unique in one respect. It included, along with the usual list of recommended changes, a detailed enumeration of the positive features of the new dental laboratory. The 2½-ton, 6x6, van body truck was praised as an extremely satisfactory laboratory vehicle for field use. The heating, plumbing, and ventilating units with which the laboratory had been equipped were stated to have performed efficiently during the tests; ceiling and side wall lamps were described as well placed and adequate for proper illumination; the dual power system was regarded as very satisfactory. As for supply storage space, the testing agency reported that the eighteen bench drawers were well placed and of suitable size, that the three-shelved closet beneath the sink was quite adequate for larger supplies, and that the filing cabinets located in the rear of



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the laboratory were entirely adequate for records, gowns, and small supplies. Miscellaneous items such as the dental engine, acetylene tanks, plaster bins, sink, work benches, and curtained windows were likewise favorably noted.<sup>62</sup>

The changes recommended by the testing agency were, without exception, of a minor character. The pilot model mobile dental laboratory could, it was conceded, function very satisfactorily as originally equipped, but there were not enough expendable items included to permit operation for more than a few days without replenishing the stock. Accordingly it was recommended: (1) that no items be deleted from present packing lists; (2) that certain items be added to present lists; (3) that the quantities specified for certain expendable and nonexpendable supplies on present packing lists, be revised upward. A consolidated list of equipment and supplies, incorporating all the above changes, was attached to the report as Inclosure No. 3.<sup>63</sup>

As for changes in the design or construction of the interior of the laboratory, the following were suggested: (1) the addition of two shallow drawers and two shelves for special storage purposes; (2) the addition of a rear wall exhaust fan for blackout operations; (3) slight reduction in width of work benches to provide a more adequate aisle space; (4) removal of water level gauge, now directly over outer edge of sink, to a position on right wall to prevent persons using sink from striking their heads on the gauge; (5) insertion of an elbow on the terminal end of the sink drain pipe so that it would no longer drain directly on the muffler.<sup>64</sup>

The report of the First Convalescent Hospital, highly favorable even in view of its recommendations for changes, was enthusiastically seconded by the Dental Surgeon, Second Army, who added the following commendation:

This pilot model of the laboratory is excellent in design and, with exceptions enumerated in basic letter, has all the facilities needed for the efficient operation in a maneuver area or Theater of Operations. It is believed that the changes recommended in basic letter will increase operational efficiency of the laboratory when operating during inclement weather or under blackout conditions.

.....  
This unit equipment is the most practical Mobile Dental Laboratory ever observed in operation by the Second Army Dental Surgeon. It has been a great asset to the dental service of Second Army in furnishing necessary dental laboratory service to the personnel in the

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maneuver area. This service has eliminated the necessity of returning patients to their home station for construction of dentures, thus preventing loss of valuable time from field training. . . .<sup>65</sup>

It was accordingly recommended: (1) that the Mobile Dental Laboratory be adopted, standardized, and procured for use in Theaters of Operation where fixed dental installations were not available; and (2) that the pilot model which had just been tested be continued in use in maneuver and training areas in the Zone of the Interior for rendering field dental laboratory service.<sup>66</sup>

This latter recommendation was obligingly narrowed by Headquarters, Second Army to the following:

2. Due to the large number of Second Army personnel in the Tennessee Maneuver Area requiring dental prosthesis, who would otherwise lose valuable training by forced absence from the Maneuver Area, it is recommended that the Second Army be authorized to retain the Mobile Dental Laboratory during the entire Maneuver period, for the continuance of this service.<sup>67</sup>

Thus far everything was progressing smoothly. The First Convalescent Hospital has rendered its test report promptly and had made clear its over-all approval of the Laboratory. The report had been forwarded up through channels as far as Headquarters of the Second Army in less than a week's time; and had been favorably indorsed by the two echelons immediately above the testing agency. Manifestly, judging from the correspondence thus far (and especially in view of the proposed retention of the pilot model laboratory by Second Army) it was the opinion of those who had seen the laboratory in operation that the suggested modifications could be readily effected simply by appropriate changes in specifications and the preparation of a new equipment list.

This view was not, however, shared by Army War College which, as representative of Army Ground Forces, was the next office to receive the test report and its allied indorsements. Replying on 11 July 1943, two weeks after Headquarters, Second Army, had made its observations, Army War College conditioned its approval of the new dental laboratory upon the carrying out of the following:

2. Due to the large number of changes recommended for modification of the Mobile Dental Laboratory, it is believed that this unit should be field tested under the supervision of the same

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testing officer, after modifications are completed.

3. This Headquarters approves the modification and inclosures thereto and requests that the equipment, when modified, be service tested in the maneuver area for a period of not less than one month before the equipment is adopted and standardized.<sup>68</sup>

Had the changes recommended by the testing agency been of such a nature that the operational soundness of the new laboratory would not have been clearly established until an actual physical modification of the vehicle had been made, the above proposal would have had an evident justification. As it was, however, the request seemed impractical. The dental laboratory project had already been so critically delayed, that it would be well into 1944 before the first factory models arrived overseas. To postpone standardization of the laboratory for several months more--for the sole purpose of observing the operational effect of a 5-inch narrowing of work benches, the addition of a rear wall exhaust fan, or the inclusion of more complete equipment and supplies for which there was already ample storage space--scarcely seemed to be a desirable course of action at this late stage.

Consequently, Army Ground Forces' proposal was permitted to die of inattention. On 15 July 1943, Headquarters, Army Service Forces, in forwarding the foregoing test report and indorsements to The Surgeon General, merely stated that the modifications recommended in basic letter and first indorsement were approved. No reference was made to the third indorsement submitted by Army War College.<sup>69</sup> Taking its cue, The Surgeon General's Office wrote the Equipment Laboratory, on 27 July 1943, to submit revised specifications and drawings covering the changes suggested by the First Convalescent Hospital. The Laboratory was informed that the pilot model would remain with the Second Army for further service during maneuvers.<sup>70</sup> On the same date the Plans Division of The Surgeon General's Office forwarded copies of the test report and inclosures to the Dental Division, and requested that in line with the recommendations contained therein a new consolidated equipment list be prepared in time for submission to the Medical Department Technical Committee at its next meeting.<sup>71</sup>

By 9 August 1943, all revisions of specifications, drawings, and equipment list had been completed.<sup>72</sup> The mobile dental laboratory was now ready for standardization.

Interior and exterior views of the new laboratory (see Figs. 27 and 28) are shown on the pages immediately following.

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#### IV Standardization and Procurement.

##### A. Standardization Proceedings.

In processing the new mobile dental laboratory for standardization, excellent coordination was maintained within The Surgeon General's Office and also between that office and Army Ground Forces. On 14 August 1943, the Director of the Dental Division was notified that standardization of the mobile dental laboratory was on the agenda for the next meeting of the Medical Department Technical Subcommittee and that, accordingly, the attendance of a representative of his Division was desired. At the same time chassis and van body specifications of the dental vehicle, as recently revised by the Equipment Laboratory, were inclosed for study and comment.<sup>73</sup>

On 23 August 1943, the Medical Department Technical Subcommittee met, and, after re-approving the statement of military characteristics which had been formulated at the time of project initiation, adopted the following recommendation:

In accordance with paragraph 13, AR 850-25, the Subcommittee recommends that this item be classified as standard article without further service test. Modifications in pilot model were not such as to require further service test.<sup>74</sup>

Thus, at last, the attitude of the Medical Department toward Army Ground Forces' proposal of 11 July 1943, was officially written into the record.

In recommending standardization of the new laboratory, the Subcommittee included among its proposals: (1) adoption of the nomenclature, "Laboratory, Dental, Mobile"; (2) adoption as basis of issue; one laboratory per Dental Prosthetic Team; (3) assignment to the Medical Department of storage, issue, procurement and purchase responsibility. Unit cost of the item (vehicle and equipment) was estimated at \$5,780. Total procurement for 1943, 1944, and 1945, if recommended basis of issue were approved, was estimated at 54 mobile units. Total cost of this procurement was placed at approximately \$312,121. It was recommended that the laboratory be classed as a critical essential item and be granted a starred priority.<sup>75</sup>

On 6 September 1943, the Medical Department Technical Committee met and approved its Subcommittee report with only two modifications. The nomenclature of the laboratory was changed to "Truck, 2½-Ton, 6x6, Laboratory, Dental", to conform to the catalog listings of the medical laboratory and surgical trucks. The responsibility for purchase of the truck, less medical equipment, was assigned to Ordnance Department. Apparently



no objections were raised by the Army Ground Forces representative to immediate standardization of the laboratory without further service testing. The proceedings were indorsed by all members present.<sup>76</sup>

Four days later all standardization data was forwarded by The Surgeon General's Office to Headquarters, Army Service Forces, with the request that the recommendations of the Medical Department Technical Committee be approved.<sup>77</sup> On 23 September 1943, standardization of the mobile dental laboratory was approved by Army Service Forces,<sup>78</sup> and notification of this action was immediately sent by the Plans Division to all interested Services and Divisions of The Surgeon General's Office.<sup>79</sup>

Although all the procedural requirements of AR 850-25 had been scrupulously followed, the subject item had been processed in approximately one month's time. This was one of the Medical Department's best administrative performances to date.

#### B. Procurement Activities.

While, as we have seen, representatives of the Dental Division, the Plans Division, and Army Ground Forces had no difficulty in reaching an agreement that the new mobile dental laboratory should be issued on the basis of one per dental prosthetic team, the question arose almost immediately as to the number of dental prosthetic teams to be allotted to a Theater of Operations or the Zone of the Interior, and the organizational basis upon which such an allotment was to be calculated.

According to the tables of organization in force at the time when the mobile dental laboratory was being standardized, the only Medical Department unit to which dental prosthetic teams were assigned was the Auxiliary Surgical Group. Instead of being allotted on the basis of one per Field Army, these Groups had been authorized for Theater of Operations use "as required."<sup>80</sup> As a result, only a small number of units had been activated. As of September, 1943, a total of only five Auxiliary Surgical Groups were reportedly in existence. Under these circumstances, the prospect of establishing an adequate quantity requirement for the new mobile dental laboratory was dim indeed. It was rendered even dimmer by the fact that an official recommendation had already been made to reduce the number of dental prosthetic teams allotted to the Auxiliary Surgical Group from three per Group to two.<sup>81</sup>

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The likelihood of having only ten mobile dental laboratories (two for each Group then in existence) for overseas use was one which the Dental Division of The Surgeon General's Office could scarcely view with complacency. Accordingly, on 7 September 1943, a vigorous protest was made by this Division to the Chief of the Operations Service. The purpose of the mobile dental laboratory, it was pointed out, was to repair and remake dentures in forward areas, so that military personnel would not have to be evacuated for this dental treatment. Inasmuch as 32 per cent of dental prosthetic service overseas consisted of just such repairs and remakes, the urgent need for mobile units was self evident. However, the Dental Division continued, the number of prosthetic teams currently authorized was entirely inadequate to furnish an effective service for tactical units. This statement, it was observed, was supported by the latest reports from the active Theaters.<sup>82</sup>

It was, therefore, recommended by the Dental Division that: (1) dental prosthetic teams be deleted from the table of organization of the Auxiliary Surgical Group and attached to General Headquarters Reserve, in a number equal to one per division for each Theater of Operations; (2) ten additional prosthetic teams be allocated to furnish dental prosthetic service for Ground Force Training Centers in the Zone of the Interior.<sup>83</sup>

On 11 September 1943, Operations Service replied that it did not concur in the recommendation for deleting the dental prosthetic teams from the Auxiliary Surgical Group and that, in any event, request for attaching these teams to General Headquarters would have to originate with Army Ground Forces as it would be their tables of organization and equipment, rather than the Medical Department's, which would be affected. It was recommended, however, that the assignment of the mobile dental laboratory in Theaters of Operations be revised to read: "upon the request of the theater commander, not to exceed one (1) per Division and/or equivalent number of ground and service combat troops."<sup>84</sup> It was clear, from this last proposal, that a compromise was in the offing.

Final settlement of this issue, which was effected in the spring of 1944--just a few weeks after the first factory models of the new laboratory came off the assembly line--was somewhat different from what either party to the dispute had previously proposed. On 23 April 1944, the Auxiliary Surgical Group, which before had been separately organized, was made a part of the Medical Department Service Organization which had been established in July, 1943, to provide administrative and supply overhead for a wide variety of specialized cellular teams. The dental prosthetic



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team (mobile), consisting of one prosthodontist and three enlisted technicians, was accordingly absorbed in the new parent unit. Its basis of assignment for service in the communications zone was, however, still expressed by the phrase, "as required".<sup>85</sup> This defect was remedied when Table of Organization 8-500, Medical Department Service Organization, was revised 18 January 1945. It was then specified that dental prosthetic teams were to be "normally assigned" on the basis of "one team per 30,000 military personnel."<sup>86</sup>

The Medical Department Service Organization described above was designed to function primarily in the Communications Zone. Extension of dental prosthetic service into the Combat Zone--the area in which such service was also drastically needed--had, therefore, to be effected through some other organization. To meet this need, on 17 March 1944 two dental prosthetic teams were added to the table of organization and equipment of the Medical Depot Company, Combat Zone, which unit was authorized on the basis of one depot company per 75,000 troops. This authorization, it may be noted, was subsequently decreased, 11 August 1944, to a "suggested assignment" of one depot company per 125,000 troop strength.<sup>87</sup>

An idea of the planned distribution of dental prosthetic service as between Combat Zone and Communications Zone can be obtained from the fact that, according to 1943 troop basis figures, only 4 Medical Department Service Organizations would be required in 1944, whereas 37 Medical Depot Companies would be required, the latter number to be increased to 43 before the close of the year.<sup>88</sup> In terms of immediate requirements for the new mobile laboratory, therefore, only 4 (1 laboratory vehicle per Medical Department Service Organization) were authorized for Communications Zone operation, whereas 74 (2 laboratory vehicles per Medical Depot Company) were authorized for use in Combat Zones.<sup>88</sup>

While the foregoing discussions were being carried forward by the Dental Division in an attempt to establish a more realistic requirements figure for the mobile dental laboratory an equally determined effort was being made by other Divisions of The Surgeon General's Office to get at least a minimum number of the new units into the field as quickly as possible. On 19 October 1943--less than a month after request for standardization of the new laboratory had been approved by higher authority--The Surgeon General's Office requested permission of the Commanding General, Army Service Forces, to divert 19 trucks from the 1943 requirements for the Truck, Surgical, so that these vehicles could be converted immediately into dental laboratory units.<sup>89</sup>

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This authority was granted within a week,<sup>90</sup> but the necessity of preparing a fairly detailed plan covering the mechanics of the conversion work to be undertaken delayed matters considerably. It was not in fact until 24 November 1943, when a conference was held in New York City between representatives of the Equipment Laboratory and the Army Medical Purchasing Office, that all conversion details were finally settled.<sup>91</sup> Inasmuch as requisitioning procedures consumed another two weeks' time, it was not until 7 December 1943 that a formal purchase order for the 19 dental laboratory trucks had cleared Army Medical Purchasing Office.<sup>92</sup>

Deliveries on this initial order were widely spaced. While eleven of the dental laboratory vehicles were delivered on 3 March 1944, the remaining eight did not reach medical depots until 25 March 1945, over a year later. Meanwhile, however, orders were placed for the direct construction of additional dental laboratory trucks (no conversion involved). By 31 October 1945, of the grand total of 107 vehicles which had been ordered by the Medical Department, all had been completed by the factory and shipped to designated supply depots in the Zone of the Interior.<sup>93</sup>

Actual overseas shipment of the Mobile Dental Laboratory was somewhat slow in getting started. In the South Pacific, for example, the first two units to be received--one at Guadalcanal and a second at Esprit de Santos in the New Hebrides--did not arrive until 31 October 1944. The laboratory truck at Esprit de Santos, the first to go into operation in this area, was placed in service in the early part of November 1944. This, it may be observed, was virtually 12 months after standardization of the truck had been accomplished.<sup>94</sup>

An idea of the distribution of the mobile dental laboratory among the various Theaters of Operation can be gained from the following table.<sup>95</sup>

Truck, 2½-Ton, 6x6, Laboratory, Dental  
(Item No. 9958700)

<u>Theater of Operation</u>	<u>Vehicles Authorized by</u>
	<u>31 Dec. 1944</u>
Pacific Ocean Area	5
North African Theater (USA)	2
China-Burma-India	4
South Pacific Base Command	4
European Theater of Operations	30
Southwest Pacific Area	15
TOTAL	60

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It will be noted that 50 per cent of the vehicles authorized for 1944 were scheduled to go to the European Theater, 25 per cent were earmarked for the Southwest Pacific Area, with the remaining 25 per cent widely scattered among all other active theaters. This general distribution pattern was maintained without significant change in the estimates prepared for 1945.<sup>96</sup>

C. Project Termination.

Standardization of the dental laboratory having been completed on 23 September 1943, in its progress report for October the Medical Department Equipment Laboratory requested that Development Project, F-24 be dropped from the active list.<sup>97</sup> Since there was no further experimental work to be accomplished and since procurement action was now being initiated, authority to terminate the project was granted by The Surgeon General's Office on 14 November 1943.<sup>98</sup>

V. Conclusion.

A. Physical Evaluation.

Aside from the addition to unit equipment, in January, 1945, of a 1-ton Ordnance trailer to provide extra cargo space for the more bulky equipment items, such as portable power units,<sup>99</sup> no major change was made in the mobile dental laboratory following its standardization in July, 1943. As for the trailer addition, the same change, it will be recalled, had been made in the case of the Army Medical Laboratory.<sup>1</sup>

Turning now to a comparison of the mobile dental laboratory with the 1-chest unit of World War I and the 2-chest portable laboratory of the thirties, the superiority of the new model on almost every count was evident at a glance. The new laboratory was vastly better equipped, both quantitatively and qualitatively. It possessed its own integral transportation, and hence could be moved readily from one location to another. Self-sufficient, from both a professional and operational standpoint, the laboratory was able to function with efficiency at any hour of the day or night, in the most inclement weather, and under conditions of complete blackout.

Because of these many advantages the new mobile dental laboratory was, from a tactical viewpoint, an almost revolutionary improvement over everything that had gone before. As was pointed out in the December, 1943 issue of

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The Bulletin of the U. S. Army Medical Department:

..... This laboratory will permit the making of new prosthetic appliances (dentures) or the repair of such in any of the forward areas of combat. Troops needing new dentures, the result of extractions or repairs, are at present evacuated to some fixed installation in the rear where laboratory facilities are available. The new mobile laboratory will eliminate the necessity for such evacuation and thereby contribute immeasurably to the war effort.<sup>2</sup>

The acid test, of course, was the reaction of using agencies. In the case of the mobile dental laboratory, the "field reaction" appears thus far to have been uniformly favorable. As we have already seen, the First Convalescent Hospital, after subjecting the laboratory to constant and rigorous testing over an extended maneuver period, was greatly impressed with the unit's over-all efficiency; and this evaluation was substantiated by the Dental Surgeon of the Second Army and by Headquarters, Second Army.<sup>3</sup> Excellent reports have since been received from the Southwest Pacific and other overseas installations.<sup>4</sup>

The mobile dental laboratory, it would appear from the evidence at hand, has been an outstanding success and has more than fulfilled the expectations of those officers who in 1939 and 1941 so strongly urged its development.

B. Administrative Aspects.

In many respects the administrative performance of Medical Department personnel during the course of Development Project, F-24 was a distinct improvement over previous efforts--especially those described in the preceding chapter. For one thing, a balanced and well coordinated relationship was maintained throughout the life of the project between the Dental Division of The Surgeon General's Office and the Medical Department Equipment Laboratory. Aside from one three-month delay which occurred at the outset (submission of an initial equipment list by the Dental Division), there were none of the difficulties which had so repeatedly deadlocked the Equipment Laboratory and Army Medical School during the development of the Army medical laboratory. There were no prolonged controversies over minute details of interior truck design, no unexpected unilateral revisions of equipment lists, and no last-minute requests for the remodelling of cabinets and work benches already permanently installed. In short, instead of a spirit

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of antagonism, a definite spirit of cooperation--certainly an essential ingredient in any successful administrative relationship--constantly prevailed between the Dental Division and the Equipment Laboratory.

The processing activities carried on by the Plans Division, the Subcommittee of the Medical Department Technical Committee, and the Medical Department Technical Committee itself, were likewise efficiently handled for the most part. From the time project initiation was first requested by the Dental Division to final authorization by the Adjutant General, only  $2\frac{1}{2}$  months elapsed. Less than a month was required to process the completed dental laboratory for standardization. This  $3\frac{1}{2}$ -month total for these two major procedural actions was virtually a record minimum. It should be noted, moreover, that complete conformance with the provisions of AR 850-25 was maintained in both instances.

There was one administrative activity, however, in which a definite breakdown had occurred. This was the procurement of materiel and supplies essential for experimentation. As we have seen, all substantive research and development activity was held to a stand-by basis for over twelve months because of: (1) a three-month delay in obtaining a suitable experimental vehicle; followed by (2) a nine-month delay in the delivery of needed equipment and supplies. The basic causes of this excessive slowness in procurement are not, however, easy to assess. A deliberate attempt had been made to avoid the requisitioning difficulties encountered in previous projects by adopting a centralized, instead of a decentralized, purchasing system. Clearly this reform, by itself, had not been enough to solve the problem.

Though they at best offer only a partial explanation of these serious procurement delays, three facts emerge from the data at hand as particularly relevant. First, there was a definite scarcity of dental prosthetic supplies and equipment in the various medical depots. Second, these research and development purchase orders had been accorded no special priority ratings. Third, though its procurement position was stronger than that of the Equipment Laboratory, The Surgeon General's Office, for reasons not apparent from the data, had failed to exploit to the full its role as expediter. The evidence does not indicate that a systematic attempt was made to follow up requisitions closely, to canvass additional medical depots when stocks in nearby depots were found to be exhausted, or to ascertain the reasons for unexplained slow deliveries. Such telegraphic follow-ups as were made, judging from all filed project data, were made by Equipment Laboratory personnel at Carlisle Barracks.

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A final word should be said regarding inter-Service coordination. Army Ground Forces' delay in replying to The Surgeon General's request for designation of a field testing agency has already been commented upon in this study. In contrast, the highly expeditious performance of the Second Army, and in particular the First Convalescent Hospital, is deserving of special mention. Only a minimum amount of time elapsed between the arrival of the pilot model mobile dental laboratory at the Tennessee Maneuver Area and the subjection to official service tests. On the third day following completion of these tests, a complete report of findings was prepared by the First Convalescent Hospital. Within a week this document had been read, carefully commented upon, and forwarded, first by the Dental Surgeon, Second Army, and then by Headquarters, Second Army.

A more intensive study of the post-developmental procurement aspects of this project would have to be made before a satisfactory explanation could be ventured for the delays which occurred between the time vehicle orders were first placed with the Ordnance Department and final delivery overseas of the completed laboratory assemblies. Suffice it to say that approximately twelve months elapsed between standardization of the mobile dental laboratory and quantity shipment of the item to active theaters.

C. The Time Element.

Considered purely from the standpoint of its battle utility during World War II, the mobile dental laboratory saw at least as much actual service overseas as the mobile medical laboratory. In some instances, it appears to have seen more. The Army medical laboratory was not shipped to overseas theaters until the first quarter of 1945, whereas, as we have seen, the dental laboratory truck was in use in certain areas of the South Pacific as early as November, 1944.<sup>5</sup> In short, considering that the subject project had been initiated at a much later date than the medical laboratory project, the showing in the present instance was not unimpressive.

It should be pointed out, in closing, that such delays as occurred during the course of Development Project, F-24, occurred mainly in the fields of procurement: pre- and post-developmental. Personnel charged with the substantive aspects of research and development had acquitted themselves exceptionally well. The speed with which the pilot model surgical truck, once it was available, had been converted into a dental laboratory truck, and the speed with which cabinets, window frames, power facilities, equipment and supplies had been installed, once they had been delivered

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to the Equipment Laboratory, was little short of phenomenal. Less than 60 man-days of work appears to have been necessary for the completion of all of these activities. In comparison to previous projects this record was outstanding.

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FOOTNOTES TO CHAPTER VII

- <sup>1</sup>Annual Report of The Surgeon General, U.S. Army, 1919, Vol. II, p. 1303.
- <sup>2</sup>Ibid.
- <sup>3</sup>Ibid., p. 1301.
- <sup>4</sup>Ibid., p. 1303.
- <sup>5</sup>Ibid., pp. 1303-1304.
- <sup>6</sup>Annual Report of The Surgeon General, U.S. Army, 1920, p. 303.
- <sup>7</sup>Annual Report of The Surgeon General, U.S. Army, 1921, p. 122.
- <sup>8</sup>Memo. to T.S.G., fr. Dental Div., S.G.C., 11 Sep. 1941; subject: "Field Dental Laboratory" (M.D.E.L.). The discussion of this laboratory in the pages which follow is based largely upon the above memorandum.
- <sup>9</sup>Ibid.
- <sup>10</sup>Ibid.
- <sup>11</sup>Ibid.
- <sup>12</sup>Ibid., Annex No. 1.
- <sup>13</sup>Supra, p. 373.
- <sup>14</sup>Memo. to Dir., Plans and Training Div., S.G.C., fr. Capt. Page, Plans and Training Div., 15 Sep. 1941 (Dental Div., S.G.C.).
- <sup>15</sup>Supra, p. 325.
- <sup>16</sup>Memo. to Exec. Officer, S.G.C., fr. Chf., Plans and Training Div., 17 Sep. 1941 (Dental Div., S.G.C.).

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- 17 Ltr. to M.D.T.C., fr. Medical Dept. Technical Subcommittee, 23 Aug. 1941; subject: "Laboratory, Dental, Mobile" (A.M.R. & D. Bd.).
- 18 History of The Army Dental Corps; Equipment and Supply, 1941-1942-1943, prepared by Dental Div., S.G.O., draft copy, p. 15 (Hist. Div., S.G.O.).
- 19 Min. of M.D.T.C., Meeting No. 3, 17 Nov. 1941, pp. 9-10 (Hist. Div., S.G.O.).  
For text of military characteristics see: ltr. to M.D.T.C., fr. Medical Dept. Technical Sub-Committee, 23 Aug. 1943; subject: "Laboratory, Dental, Mobile" (A.M.R. & D. Bd.).
- 20 Blueprint #26303, Mobile Dental Laboratory; prepared by Ritter Dental Mfg., Co., Inc., Rochester, N.Y. (Dental Div., S.G.O.).  
For Dental Division comment on above, see draft copy of memo. to T.S.G., fr. Dental Div., 20 Aug. 1941; subject: "Field Dental Laboratories," Annex 3 (Dental Div., S.G.O.).
- 21 Memo. notes of Lt. Col. K.H. Metz, 27 Aug. 1941 (Dental Div., S.G.O.).
- 22 Memo. to Dental Div., S.G.O., fr. Office of Chf. of Ordnance, 29 Aug. 1941; subject: "1½-ton G.M.C. Ordnance Technical Trucks" (Dental Div., S.G.O.).
- 23 Ordnance Department Photographs Nos. 37572 and 37574, "Ordnance Machine Shop Truck," 9 Jan. 1939 (Dental Div., S.G.O.).
- 24 See n. 8, p. 436.
- 25 See n. 16, p. 436.
- 26 See n. 17, above.
- 27 Ltr. to T.A.G., fr. S.G.C., 18 Nov. 1941; subject: "Research Project - Mobile Dental Laboratory" (A.M.R. & D. Bd.).
- 28 1st Ind. to S.G.O., fr. T.A.G., 27 Nov. 1941; basic: see n. 27, above (A.M.R. & D. Bd.).

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29 Monthly Progress Report, M.D.E.L., Dec., 1941 (A.M.R. & D. Bd.).

30 Ltr. to Chf., Dental Div., S.G.O., fr. Lt. Col. Neal A. Harper, D.C., Carlisle Bks., Pa., 8 Dec. 1941 (Dental Div., S.G.O.).

31 Ltr. to Hist. Div., S.G.O., fr. M.D.E.L., 23 Nov. 1945; subject: "History, Project F-24 - Truck 2 $\frac{1}{2}$ -Ton, 6x6, Laboratory Dental," Incl. 1, p. 5 (Hist. Div., S.G.O.).

32 Monthly Progress Report, M.D.E.L., Jan., 1942 (A.M.R. & D. Bd.).

33 Ltr. to S.G.O., fr. M.D.E.L., 18 Mar. 1942; subject: "Mobile Dental Laboratory" (M.D.E.L.).

34 1st Ind. to M.D.E.L., fr. Dental Div., S.G.O., 20 Apr. 1942; basic: see n. 33, above (M.D.E.L.).

35 2d Ind. to S.G.O., fr. M.D.E.L., 23 Apr. 1942; basic: see n. 33, above (M.D.E.L.).

36 Monthly Progress Report, M.D.E.L., 1 May - 9 Jun. 1942 (A.M.R. & D. Bd.).

Monthly Narrative Report, M.D.E.L., 10 Jun. - 9 Jul. 1942 (A.M.R. & D. Bd.).

Monthly Narrative Report, M.D.E.L., 10 Jul. - 9 Aug. 1942 (A.M.R. & D. Bd.).

37 Monthly Narrative Report, M.D.E.L., 10 Jun. - 9 Jul. 1942; see penciled notation, 29 Apr. 1942 (A.M.R. & D. Bd.).

38 Supra, p. 315.

39 Ltr. to S.G.O., fr. M.D.E.L., 3 Aug. 1942; subject: "Construction Pilot Model Dental Laboratory" (M.D.E.L.).

40 1st Ind. to M.D.E.L., fr. S.G.O., 5 Aug. 1942; basic: see n. 39, above (M.D.E.L.).

41 Ltr. to Hist. Div., S.G.O., fr. M.D.E.L., 23 Nov. 1945; subject: "History, Project F-24 - Truck 2 $\frac{1}{2}$ -Ton, 6x6, Laboratory Dental," Incl. 1, pp. 6-7 (Hist. Div., S.G.O.).

42 Ibid., p. 7.

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- 43 Monthly Narrative Report, M.D.E.L., 10 Nov. - 9 Dec. 1942  
(A.M.R. & D. Bd.).
- 44 Monthly Narrative Report, M.D.E.L., 10 Jul. - 9 Aug. 1942  
(A.M.R. & D. Bd.).
- 45 2d Ind. to S.G.O., fr. M.D.E.L., 23 Jul. 1942; basic: see  
n. 33, p. 438 (M.D.E.L.).
- 46 Memo. to Finance & Supply Div., S.G.O., fr. Dental Div.,  
S.G.O., 21 Jul. 1942 (Dental Div., S.G.O.).
- 47 Ltr. to Hist. Div., S.G.O., fr. M.D.E.L., 23 Nov. 1945; sub-  
ject: "History, Project F-24 - Truck 2 $\frac{1}{2}$ -Ton, 6x6, Labora-  
tory Dental," Incl. 1, p. 6 (Hist. Div., S.G.O.).
- 48 Ibid., pp. 7-8. See, also, telegram No. 4 to Medical Supply  
Depot, Savannah, Ga., fr. M.D.E.L., 12 Dec. 1942, "Undelivered  
Items" (M.D.E.L.).
- 49 Monthly Narrative Report, M.D.E.L., 10 Dec. 1942 - 9 Jan.  
1943 (A.M.R. & D. Bd.).
- 50 Deduced from comparative study of M.D.E.L. Photographs S-266,  
"Truck, Surgical," and S-39, "Mobile Dental Laboratory"  
(Hist. Div., S.G.O.).
- 51 See n. 49, above.
- 52 Monthly Narrative Report, M.D.E.L., 10 Jan. - 9 Feb. 1943  
(A.M.R. & D. Bd.).
- 53 Ltr. to Hist. Div., S.G.O., fr. M.D.E.L., 23 Nov. 1945;  
subject: "History, Project F-24 - Truck 2 $\frac{1}{2}$ -Ton, 6x6; Labo-  
ratory Dental," Incl. 1, p. 8 (Hist. Div., S.G.O.).  
See also n. 52, above.
- 54 Ltr. to M.D.E.L., fr. S.G.O., 15 Jan. 1943 (Rec. Rm., S.G.O.  
451.2-1 Carlisle Bks.-N).
- 55 Memo. to Chf., Dental Div., S.G.O., fr. Exec. Office, S.G.O.,  
20 Nov. 1942 (Dental Div., S.G.O.).

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- 56 Ltr. to C.G., A.G.F., fr. S.G.O., 12 Feb. 1943; subject: "Mobile Dental Laboratory" (Rec. Rm., S.G.O. 451.2-1).
- 57 2d Ind. to C.G., 2d Army, Memphis, Tenn., fr. Hq., A.G.F., 6 Mar. 1943; basic: see n. 56, above (Rec. Rm., S.G.O. 451.2-1).
- 58 3rd Ind. to C.G., A.G.F., fr. Hq., 2d Army, Memphis, Tenn., 16 Mar. 1943; basic: see n. 56, above (Rec. Rm., S.G.O. 451.2-1).
- 59 6th Ind. to M.D.E.L., fr. S.G.O., 3 Apr. 1943; basic: see n. 56, above (Rec. Rm., S.G.O. 451.2-1).
- 60 Monthly Narrative Report, M.D.E.L., 1 - 30 Apr. 1943 (A.M.R. & D. Bd.).
- 61 Ltr. to The Surgeon, 2d Army, Memphis, Tenn., fr. 1st Convalescent Hospital, APO 402, Nashville, Tenn., 22 Jun. 1943; subject: "Report on Test of Pilot Model of Mobile Dental Laboratory," with 3 incls. (A.M.R. & D. Bd.). For text of this report see Appendix H.
- 62 Ibid.
- 63 Ibid.
- 64 Ibid.
- 65 1st Ind. to C.G., 2d Army, fr. Office of Dental Surgeon, Hq., 2d Army, Memphis, Tenn., 24 Jun. 1943; basic: see n. 61, above (A.M.R. & D. Bd.).
- 66 Ibid.
- 67 2d Ind. to C.G., A.G.F., Army War College, fr. Hq., 2d Army, Memphis, Tenn., 28 Jun. 1943; basic: see n. 61 (A.M.R. & D. Bd.).
- 68 3rd Ind. to C.G., A.S.F., fr. Hq., A.G.F., Army War College, 11 Jul. 1943; basic: see n. 61, above (A.M.R. & D. Bd.).
- 69 4th Ind. to S.G.O., fr. Hq., A.S.F., 15 Jul. 1943; basic: see n. 61, above (A.M.R. & D. Bd.).



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- 70 5th Ind. to M.D.E.L., fr. S.G.O., 27 Ju. 1943; basic: see n. 61, p. 440 (A.M.R. & D. Bd.).
- 71 Memo. to Dental Div., S.G.O., fr. Plans Div., S.G.O., 27 Jul. 1943; subject: "Mobile Dental Laboratory" (A.M.R. & D. Bd.).
- 72 1st Memo. Ind. to Plans Div., S.G.O., fr. Dental Div., 30 Jul. 1943; basic: see n. 71, above (A.M.R. & D. Bd.).  
6th Ind. to S.G.O., fr. M.D.E.L., 9 Aug. 1943; basic: see n. 61, p. 440 (A.M.R. & D. Bd.).
- 73 Memo. to Dir., Dental Div., S.G.O., fr. Secy., M.D.T.C., 14 Aug. 1943; subject: "Proposed Action by Subcommittee of Medical Department Technical Committee on Mobile Dental Laboratory" (A.M.R. & D. Bd.).
- 74 Ltr. to M.D.T.C., fr. Subcommittee on Field Equipment, 23 Aug. 1943; subject: "Laboratory, Dental, Mobile" (A.M.R. & D. Bd.).
- 75 Ibid.
- 76 Min. of M.D.T.C., Meeting No. 9, 6 Sep. 1943, RESTRICTED (Hist. Div., S.G.O.). Extracted in clear.
- 77 Ltr. to C.G., A.S.F., fr. S.G.O., 10 Sep. 1943; subject: "Truck, 2½-Ton, 6x6, Laboratory, Dental" (A.M.R. & D. Bd.).
- 78 2d Ind. to S.G.O., fr. Hq., A.S.F., 23 Sep. 1943; basic: see n. 77, above (A.M.R. & D. Bd.).
- 79 Memo. to Chf., Supply Service; Dir., Fiscal Div.; Chf., Professional Service; Chf., Operations Service; fr. Plans Div., S.G.O., 25 Sep. 1943; subject: "Truck, 2½-Ton, 6x6, Laboratory, Dental" (A.M.R. & D. Bd.).
- 80 Table of Organization 8-571, Auxiliary Surgical Group, 13 Jul. 1942; Table of Equipment 8-571, Auxiliary Surgical Group, 25 Nov. 1942.
- 81 Memo. to Operations Service, S.G.O., fr. Dir., Dental Div., S.G.O., 7 Sep. 1943 (Dental Div., S.G.O.).

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82 Ibid.

83 Memo. to Operations Service, S.G.O., fr. Dir., Dental Div., S.G.O., 7 Sep. 1943 (Dental Div., S.G.O.).

84 Memo. to Dental Div., S.G.O., fr. Chf., Operations Service, S.G.O., 11 Sep. 1943 (Dental Div., S.G.O.).

85 Table of Organization & Equipment 8-500, Medical Department Service Organization, 23 Apr. 1944.

86 Table of Organization & Equipment 8-500, Medical Department Service Organization, 18 Jan. 1945.

87 Table of Organization & Equipment 8-667, Medical Depot Company, Combat Zone, 17 Mar. 1944. See, also, Change 1, Table of Organization & Equipment 8-667, 11 Aug. 1944.

88 Memo. to Hist. Div., S.G.O., fr. Dental Div., S.G.O., 24 Feb. 1944. See Incl. 1, "Dental Division History, 22 January 1944 - 21 February 1944, incl., p. 1. (Hist. Div., S.G.O.).

89 5th Ind. to C.G., A.S.F., fr. S.G.O., 17 Dec. 1943; see Par. 2; basic: ltr. to Chf., Ordnance Dept., fr. S.G.O. 3 Nov. 1943; subject: "S.G.C. requisition PD 1300" (Rec. Rm., S.G.O. 451.2-1).

90 Ibid. Approval cited in 5th Indorsement.

91 Ltr. to S.G.O., fr. M.D.E.L., 29 Nov. 1943; subject: "Conversion of Surgical Trucks to Dental Laboratories" (A.M.R. & D. Bd.).

92 1st Ind. to Hist. Div., S.G.O., fr. A.M.F.C., 31 Oct. 1945; basic: ltr. to A.M.P.O., fr. Hist. Div., S.G.O., 22 Oct. 1945. (Hist. Div., S.G.O.).

93 Ibid.

94 Interview with Pearson W. Brown, Lt. Col., D.C., Historian, Dental Div., S.G.O., 19 Feb. 1946.

95 Statistical data based on ltrs. to C.G., PCA; C.G., NATOUSA; C.G., SPBC; C.G., ETO; C.G., SWPA, fr. Chf., Supply Service, S.G.O. (all dated 26 Oct. 1944); subject: "Medical Depart-



ment Trucks," CONFIDENTIAL (Rec. Rm., S.G.O. 451.2).  
Extracted in clear.

<sup>96</sup>Ibid.

<sup>97</sup>Monthly Narrative Report, M.D.E.L., 1 - 31 Oct. 1943  
(A.M.R. & D. Bd.).

<sup>98</sup>Ltr. to M.D.E.L., fr. S.G.O., 14 Nov. 1943; subject:  
"Dropping of Projects from Monthly Narrative Report"  
(A.M.R. & D. Bd.).

<sup>99</sup>Table of Organization & Equipment 8-500, Medical Department  
Service Organization, 18 Jan. 1945.

<sup>1</sup>Supra, p. 390.

<sup>2</sup>The Bulletin of the U.S. Army Medical Department, No. 71,  
Dec., 1943, p. 13.

<sup>3</sup>Supra, pp. 422-424.

<sup>4</sup>Interview with Pearson W. Brown, Lt. Col, D.C., Historian,  
Dental Div., S.G.O., 19 Feb. 1946. See, also, Essential  
Technical Medical Data, 1944-1945 (Hist. Div., S.G.C.).

<sup>5</sup>See n. 94, p. 442.





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## CHAPTER VIII

### TRUCK, $2\frac{1}{2}$ -TON, 6 x 6, OPTICAL REPAIR UNIT.

#### I. Historical Background.

##### A. Importance of Army's Optical Repair Program.

Many a man who, during the earlier days of Selective Service, was convinced that he would never be drafted because of vision defective enough to require glasses was later undoubtedly surprised to find himself inducted. Nevertheless, he was not alone; for, as he unquestionably came to realize, there were hundreds of thousands like him in the Army of the United States whose visual deficiencies could be corrected only through the wearing of spectacles.

Recalling its experience in World War I, the Army had estimated in 1940 that ten percent of all military personnel would require glasses.<sup>1</sup> And although as late as 24 December 1941 it was reported that "Records disclose an astounding correlation in the percentage of military personnel wearing spectacles during World War I and the present emergency,"<sup>2</sup> it was later determined that those requiring glasses during World War II actually numbered 18 percent.<sup>3</sup> From this figure alone the importance of the Army's optical repair program should be obvious. But if other evidence be yet desired, one could point to the fact that were it not for the optical repair facilities which were employed in the European Theater of Operations alone it would at one time have been "necessary to evacuate approximately 10,000 soldiers per month who have lost or broken their spectacles."<sup>4</sup>

##### B. Medical Department's Estimate of the Situation.

When the United States formally entered the war in December of 1941, anticipation that American expeditionary forces would require ophthalmological service overseas crystallized into prompt action to provide such service. A comprehensive estimate of the situation was made, and an officer in The Surgeon General's Office submitted on 24 December 1941 a report on what, in his opinion, was "the most practical and workable Mobile Optical Unit to facilitate the Medical Department in the maintenance of visual efficiency of Military Personnel in the Theatre of Operations."<sup>5</sup> This report pointed out that although the Base Optical Unit -- that is, a fixed installation -- which the Medical Department had established in Paris, France, during World War I had provided excellent service in filling 22,000 prescriptions

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for spectacles during its four months of operation, the Chief of Ophthalmological Service had recognized even then the advantages of mobility and had recommended that comparable optical units of the future possess this characteristic.<sup>6</sup>

Since the Medical Department estimated from Army experience in the first World War that an optical unit which could produce 60 pairs, or 120 single lenses, of spectacles daily per type army would be required, further study of the problem as outlined in this report was predicated upon these considerations: (1) type of unit necessary to provide adequate maintenance facilities in a Theater of Operations; (2) estimated production service required per type Army; and (3) extreme mobility and self-sufficiency of the optical unit.<sup>7</sup>

Two possible types of units were examined. One would consist of equipment necessary to process spectacles from the grinding and surfacing of the lenses to the finishing of the spectacles complete. Such a unit "would, in fact, be an optical factory capable of supplying spectacles of any prescription, regardless of correction"; nevertheless it would require not only large quantities of specialized tools but even tooling machines to maintain them -- the loss or destruction of which would be ruinous to continued operation; a large number of skilled personnel; and five trucks for transportation.<sup>8</sup> Mobility -- a characteristic which had been determined as a prerequisite -- would obviously be so greatly impaired in such a cumbersome unit as to be virtually non-existent. Consequently, all thought of recommending such a large, costly, complex, and immobile unit was promptly discarded.

The second type of unit considered in this preliminary investigation was described as "one in which the grinding and surfacing equipment would be eliminated, thereby reducing the equipment and weight by 60%" and one which would "contain machinery and equipment sufficient to cut, stocked semi-finished lenses down to size, shape them on a diamond cutter, [and] smooth and bevel the edges preparatory to insertion in the frames."<sup>9</sup> Its stock of lenses would be in accordance with a tariff of sizes as determined from the experience tables of principal optical suppliers of the continental United States -- a stock which would, it was believed, supply better than 99 percent of the demands. With only five men as operating personnel, this type of unit would have a greater production capacity than the more elaborate one previously described, it was thought, "because, by the elimination of the grinding and surfacing, 80% of the time element has been circumvented" and because, too, it was "designed to operate and be transported on one standard 2½ ton truck, thereby affording the maximum in mobile efficiency."<sup>10</sup> Such a unit was very liberally estimated to cost



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\$21,288.59 complete.<sup>11</sup>

Advantages claimed for the streamlined unit in addition to those already stated or implied were:

1. The five men required to operate at a capacity sufficient to produce 60 pairs of spectacles in an eight-hour day need be operators having only optical shop experience and not necessarily skilled technicians.

2. Efficiency would be increased approximately 200 percent because the need for highly specialized machinery, equipment, and skilled optical technicians would have been eliminated.

3. In emergencies, improvisations could be effected for wearers of special or unusual spectacles until their prescriptions could be supplied from the rear.

4. The unit cost would be reduced 50 percent; yet a stock of 12,000 pairs of lenses, 8,400 frames, 600 pairs of extra temples, and 1,200 spectacle cases would be included in its equipment.<sup>12</sup>

Having concluded that the smaller, compact unit was the more practical for the purposes desired, the report recommended that this type be adopted and (although six units were actually authorized almost immediately afterwards)<sup>13</sup> that "procurement be instigated to provide the establishment of two such Mobile Optical Units."<sup>14</sup>

### C. The Original Mobile Optical Repair Unit.

The mobile optical repair units thus originally recommended for adoption and procurement by the Medical Department had been developed largely by the optical industry -- in close cooperation, of course, with the Office of The Surgeon General. There is evidence aplenty to show the tremendous efforts made by at least three optical suppliers -- namely, the American, the Bausch and Lomb, and the Shuron optical companies -- in this work. They recommended equipment and supplies to be included in the proposed mobile units and drafted tentative blueprints suggesting the most convenient location for the various pieces of machinery to be installed in the 2½-ton, 6 x 6, stake-and-platform-type, tarpaulin-covered cargo truck that was to be used as a carrier. Furthermore, they assembled and supplied the complete units to the Medical Department -- originally one to each numbered Medical Supply Depot--at a time when critical shortages of optical equipment and supplies presented almost insurmountable difficulties to the sponsors of the project.<sup>15</sup>

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So impressed was the author of The Surgeon General's History of the Optical Program with the contributions made by the optical industry throughout the war that he observed particularly that the American Optical Company and Bausch and Lomb "were at all times conscious of the importance of the Army's Optical Program and never failed to be fully cooperative"; and he strongly opined that "were it not for these two companies the Army's Optical Program would be a serious failure."<sup>16</sup>

## II. Project Initiation.

Notwithstanding the remarkable contributions of industry to the development, standardization, and procurement of the original unit--Medical Department Item No. 93638, Optical Repair Unit, Mobile, Large--facilities for optical repair in the field still left much to be desired.

### A. Inadequacies of Original Unit.

On 28 October 1942 the Senior Consultant in Ophthalmology, European Theater of Operations, had declared in a memorandum to his headquarters: "It is anticipated that the present mobile optical unit will prove, on trial, to be unnecessarily cumbersome, inefficient, inadequate, an [d] unsatisfactory";<sup>17</sup> and a month later he informed The Surgeon General that "The method of supplying troops, at least in this theater, with spectacles is chaotic."<sup>18</sup> One of the four "causes of this impossible situation," he believed, was "The present unnecessarily complicated field optical unit which is not enough simplified for field use and contains some equipment that is cumbersome and unessential for rapid work"; and so he recommended, among other things, "The abolition of the present mobile optical unit."<sup>19</sup> Having reviewed this report of overseas difficulties, the Chief of the Optical Branch, Surgeon General's Office, indicated on 24 December 1942 that the entire question of replacement of equipment and supplies for overseas is presently under active consideration by this office."<sup>20</sup>

Review of the inadequacies of the overseas program continued for several months, during which time it was decided that not abolition of the standard mobile repair unit--as had been recommended by the Senior Consultant in Ophthalmology, European Theatre of Operations--nor even simplification of it would alleviate the chaos in overseas optical supply; instead, a more complex unit was actually to be desired.

The nature of this decision and some of the reasons for it are well stated in the following memorandum



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from the Chief of the Specialties Branch (formerly Chief of the Optical Branch) to the Plans Division, Field Equipment Branch:

1. This office has had under consideration the furnishing of all optical repair units, including mobile units, with the minimum equipment necessary to take care of essential surfacing work in the case of bifocals and prisms. Reports from all theatres of operation have evidenced the need for such equipment as the units are apparently able to take care of only about 85% of repairs and replacements with their present equipment.

2. The Surgeon General, during a recent inspection trip overseas, recognized the need for this additional equipment, and has directed that it be provided immediately.

3. In view of the foregoing, this office is proceeding with the necessary arrangements to augment the equipment in all these units, and to determine the most practical method of providing the additional equipment in the present mobile units. There is no space available in the latter for additional equipment, but it is not felt necessary at this time to revise specifications on the entire unit, redesign the layout, etc., but rather to simply send along the additional equipment for use with the unit. As a matter of fact, a number of these units are operating as shops with the equipment removed from the truck.

4. This matter will be coordinated fully with the Plans Division.<sup>21</sup>

Noteworthy merely in passing is the fact that field experience required The Surgeon General to direct inclusion of equipment which, when the possibilities of employing mobile optical repair units were initially surveyed, had finally been excluded after careful consideration because, among other reasons, its omission was calculated to reduce the weight of the unit by approximately 60 percent and to increase its operating efficiency by 20 percent.<sup>22</sup>

Following issuance of the original mobile optical repair units to organizations in the field, furthermore, the fact that three separate companies had collaborated in its early development and production became as prejudicial as it had previously been helpful. Part of the chaos in supply was undoubtedly created by the fact that the mobile optical

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shop was being "supplied by three manufactures, each of whom makes a slightly different unit with parts which are not interchangeable."<sup>23</sup> As a consequence of this confusion, the Medical Department frankly admitted by mid-July 1943 that there then existed a "situation whereby we are uninformed as to the type of equipment which is being used in units in the various theaters of operations."<sup>24</sup>

#### B. Formal Initiation of Project.

On 22 June 1943 a conference was called whose pre-announced purpose was, in part, to discuss "Revision of present Mobile Optical Repair Unit in order to make it a more practical self-sustaining unit, susceptible of operation either on or off the truck"; for, it was indicated, "Minimum essential grinding or surfacing equipment is being furnished all base and mobile units and this will necessitate a complete change in specifications to permit installation of the additional equipment."<sup>25</sup>

Three days later, the Chief of the Field Equipment and Development Branch of The Surgeon General's Office requested of the Research Coordination Branch that "a research project be established for the revision of the Mobile Optical Unit."<sup>26</sup> Simultaneously the communication declared that the work was to be done at the Medical Department Equipment Laboratory; that it was "anticipated that the Truck, 2½-ton, 6x6, Surgical may be used for this purpose"; and that it was "believed particularly desirable that the best features of each of the three present Mobile Optical Units, namely, those made by American Optical, Bausch and Lomb, and Shuron be combined to form a standard unit," the effectuation of which suggestion was made "absolutely necessary" by the "need for interchangeability and replacement."<sup>27</sup>

Very promptly the Research Coordination Branch of the Plans Division informally secured from Headquarters, Army Service Forces, authority to initiate the proposed project and to spend \$1000 of research funds on the development. Having by-passed both the Subcommittee and the Medical Department Technical Committee in the processing of this request and neglecting formally to formulate the desired military characteristics for the proposed item--actions in direct contravention of the provisions of AR 850-25--the Research Coordination Branch on 30 June 1943, put the request to Army Service Forces in writing.<sup>28</sup> Other informal communication--this relative to an upward revision of the amount requested--must have immediately followed; for Headquarters, Army Service Forces, on 5 July 1943, approved initiation of the project but added that "It was understood that the amount of funds required will be \$12,000 instead of



\$1000 stated in ... basic letter."<sup>29</sup>

Yet a little more time elapsed while Research Coordination Branch of The Surgeon General's Office, fearing that a reference in its basic letter may have been misconstrued, explained to Headquarters, Army Service Forces, that "Present plans contemplate the use of the standard body of the present Surgical Truck, Medical Supply Catalogue Item No. 99590" rather than "the standard cargo truck body."<sup>30</sup> The Surgeon General's Office further stated that

It is proposed to install optical repair equipment within this body in a semi-permanent (demountable) manner, permitting relatively simple removal. Thus it may be possible to use the same body for several purposes (Mobile Dental Laboratory, Mobile Medical Laboratory and Mobile Optical Unit) by the substitution of different sets of removable equipment.<sup>31</sup>

Despite the failure to process this request through the Subcommittee and the Medical Department Technical Committee and to formulate proposed military characteristics for the item--sins against the procedural provisions of AR 850-25 which, be it said in fairness, were shortly detected and corrected, as will be described later, before any real damage could result therefrom--use of the standard Truck, 2½-Ton, 6 x 6, Surgical (Armored Force) was thereupon initially approved--on 10 July 1943.<sup>32</sup>

Old bones were inexplicably disinterred, however, by the same indorsement that granted this approval. Less than three months before, as has been discussed in Chapter V above,<sup>33</sup> Headquarters, Army Service Forces, had concurred in the recommendation--a recommendation which was supported by carefully coordinated study and cogent reasoning--that no further consideration be given to its proposal to develop the surgical truck into a knock-down type of vehicle for the purpose of facilitating shipment of the truck overseas. Despite his previously reached decision not to require a knock-down surgical truck and notwithstanding the fact that he had just approved the use of the surgical truck as a basis for the development of the new Mobile Optical Repair Unit, nevertheless, here was the Chief of the Development Branch, Plans Division, Headquarters, Army Service Forces, expressing to The Surgeon General the desire that "every effort be made to have this equipment demountable in order that the body may be removed from the truck for overseas shipment of the chassis in a twin unit pack."<sup>34</sup>

The inconsistency of these decisions may not be

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satisfactorily explained even by the possibility of a change in personnel detailed to draft the correspondence, for all identifying titles and signatures, even to the initials of the dictator and the typist, are identical on the two contradictory indorsements.<sup>35</sup> Possibly because of the inconsistency detected, however, this directive, during the active development which followed, appears to have been conveniently but tacitly ignored by the Medical Department.

### III. Development Phase.

Only five additional days having been required to effect a complete understanding with Headquarters, Army Service Forces, as to the type of body to be employed in the development of the Optical Repair Unit, the Research Coordination Branch formally notified the Field Equipment and Development Branch, the Fiscal Division, and the Optical Branch on 13 July 1943 that the project had been finally approved "with the understanding that the standard Truck, 2½-Ton, 6x6, Surgical (Armored Force) be used and every effort be made to have equipment demountable for overseas shipment."<sup>36</sup> Meantime, having relied upon the informal approval previously granted by Headquarters, Army Service Forces, various interested branches of The Surgeon General's Office had already taken action to expedite the development.

#### A. Preliminary Developmental Activities.

Nearly two weeks prior to receipt of the final authorization, the Research Coordination Branch had notified the Chief of the Field Equipment Development Branch of allocation of \$1000 of research funds and had suggested "that the Director, Specialties and Supply Planning Division ... be consulted for advice on supply details of this project."<sup>37</sup> Thereupon this memorandum was promptly transmitted, on 3 July 1943, to the Director, Medical Department Equipment Laboratory, with the recommendation that "necessary action be taken."<sup>38</sup>

With equal promptness the Director of the Equipment Laboratory, formally initiating the project, wrote the Director of the Specialties and Supply Planning Division for information "as to the type and amount of cubic space of units of equipment to be carried and installed," Tables of Equipment for the unit, and any other information "deemed necessary to give us a working basis for this project."<sup>39</sup> He further explained that, "in view of the limitation of funds, it will be necessary to develop this on an existing closed body truck such as is now in use, known as the surgical truck."<sup>40</sup>



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The Medical Department agencies handling this development were working rapidly. On the same day that Headquarters, Army Service Forces, finally approved the project--i.e., on 13 July 1943--the Chief of the Specialties Branch answered this request by indorsement. He indicated to the Director of the Equipment Laboratory that the original mobile optical repair unit as transported on the standard 2½-ton truck with tarpaulin cover had been found unsatisfactory, especially in adverse weather; that the Specialties Branch was then studying the availability of space in the surgical truck to accommodate the extra optical equipment and supplies proposed for addition to the unit; that until this space factor had been "determined with a reasonable degree of accuracy, there seems little use in having equipment forwarded to your station for installation on the surgical truck"; and that as soon as the problem was resolved, probably very shortly, "this office will communicate with you further ... in order that this development project may be pursued as expeditiously as possible."<sup>41</sup>

The Chief of the Specialties Branch further stated that

It is also the intention for purposes of uniformity to recommend the use of the equipment of each of the optical manufacturers which seems best suited to our needs compatible with the space available in the truck in order to avoid a repetition of the present situation whereby we are uninformed as to the type of equipment which is being used in the units in the various theaters of operations.<sup>42</sup>

By the end of July, 1943, the Medical Department Equipment Laboratory was able to report that Development Project, F-32, Optical Unit, Mobile, had been initiated on 3 July 1943; that "Preliminary plans have been made in regard to equipment to be installed in a van body mounted on a 2½-Ton, 6x6 truck"; and that the surgical truck which had been received by the Laboratory on 30 July 1943 was to be "converted into a pilot model mobile optical unit upon receipt of the optical equipment which is to be furnished by the Office of The Surgeon General."<sup>43</sup> Two weeks later it was estimated that the project would be completed by January 1944.<sup>44</sup>

Initiating development prior to receipt of formal authorization of the project by Headquarters, Army Service Forces, was not the only expedient resorted to during the preliminary developmental stage in an effort to speed the progress of Project, F-32. On 31 July 1943, too, the

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Director of the Medical Department Equipment Laboratory requested of The Surgeon General's Office one electric power unit (Item No. 99600) for delivery to his organization for use in the Mobile Optical Unit. This request was made, he explained, "in order that the equipment may be available at an earlier date than if requisitioned through normal channels."<sup>45</sup>

Then, on 2 August 1943, the Table of Equipment which had been previously requested was forwarded to the Director of the Laboratory with the request that the equipment be procured from the companies indicated--namely, The Shuron Optical Company and the American Optical Company--through Medical Department supply channels, and that the cost be charged against the \$12,000 of research and development funds authorized for the project.<sup>46</sup> Finally, on 10 August, 1943, the Specialties Branch requested that the Equipment Laboratory, utilizing a high priority to insure prompt delivery, purchase eight lens and eight frame cabinets from Yawman and Erbe Manufacturing Company.<sup>47</sup> The Monthly Narrative Report for August revealed that delivery of both the optical equipment and the cabinets was expected within 30 to 60 days.<sup>48</sup>

B. Rectifying Previous Violations and Prescribed Procedures.

While developmental work on Project F-32 was temporarily suspended pending delivery for the necessary equipment, appropriate agencies within The Surgeon General's Office began rectifying the apparent though unexplained violations of the procedural provisions of AR 850-25 which had been committed when the project was initiated about five weeks before. This activity consisted of formally processing the project through the Subcommittee and the Medical Department Technical Committee and of having those two committees determine the military characteristics to be proposed for approval by Headquarters, Army Service Forces.

The fact that establishment of military characteristics had been earlier overlooked appears to have been realized first--though the evidence is more inferential than palpable--during discussion of the Technical Subcommittee held 2 August 1943.<sup>49</sup> Be that as it may, after the proposed characteristics had been formally coordinated within The Surgeon General's Office,<sup>50</sup> the Technical Subcommittee on 23 August 1943 recommended approval of their statement in the following form:

- a. The unit should utilize the standard Surgical Truck chassis and body,



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b. The unit should be sufficiently complete in stock and equipment to provide repair and replacement in essentially all cases, this to include a focus range of lenses as complete as practicable and the minimum essential surfacing equipment.

c. The unit should be self-sustaining from the standpoint of light, heat, and power so that when necessary, complete operations may be performed within the unit regardless of adverse weather or blackout conditions.

d. The equipment should be securely installed in the truck, but capable of being removed.<sup>51</sup>

On 6 September 1943 the Medical Department Technical Committee approved the report of its subcommittee, but with a modification of the nomenclature to read: Truck, 2½-Ton, 6x6, Optical Repair Unit.<sup>52</sup>

With the request that "the recommendation by the Medical Department Technical Committee for adoption of military characteristics of subject item be approved," the report of the Subcommittee, the approval of the Subcommittee report with the recommended change of nomenclature, and the signed concurrences by members of the Medical Department Technical Committee were forwarded to the Commanding General, Army Service Forces, on 13 September 1943.<sup>53</sup> After coordinating the recommendations with Army Ground Forces,<sup>54</sup> Headquarters, Army Service Forces notified The Surgeon General on 7 October 1943 that the military characteristics as proposed were approved,<sup>55</sup> and this information was shortly relayed to the Chiefs of the Field Equipment Development Branch and of the Optical Branch, Procurement Division.<sup>56</sup>

Thus was atonement made for the sins against the procedural requirements of AR 850-25 which were committed not only by The Surgeon General's Office but also by Headquarters, Army Service Forces, since that office had failed to require a statement of military characteristics when Development Project, F-32 was first approved. Fortunately, however, processing this remedy through the various committees and headquarters caused no delay in the substantive development of the unit.

### C. Substantive Development.

Records relative to actual engineering and constructional activities incidental to the development of the Truck, 2½-Ton, 6 x 6, Optical Repair Unit are extraordinarily meager. This fact of itself is a tribute, however,

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to the quality of the work that had been done in developing the basic Truck, 2½-Ton, 6 x 6, Surgical. With such a versatile and adaptable vehicle to begin with, it is hardly surprising that although another window on each side of the truck had to be added, "The prime research and construction difficulty," troublesome as it was, was nothing more bothersome than finding "space for housing the multitude of special optical equipment and supplies, in the 2½ ton, 6.x 6 truck."<sup>57</sup>

Even while military characteristics were being processed for approval and while the delivery of optical equipment and supplies and steel cabinets in which to store them was being awaited, the Medical Department Equipment Laboratory was doing such work as it could on Development Project, F-32. Thus, although delivery of the steel cabinets was not expected before 1 November 1943, the Monthly Narrative Report of the Laboratory for September 1943 indicated that:

Conversion of the body of the Surgical Truck which is being used in the development of the pilot model mobile optical unit is now being accomplished. This includes the addition of one more window on each side of the body and the installation of a new electrical and plumbing system.<sup>58</sup>

As a result of this progress the Equipment Laboratory was able to send to The Surgeon General's Office on 23 October 1943 copies of "Medical Department Equipment Laboratory Drawings Nos. C-414, Piping Diagram, 2½-Ton, Van Body Truck; D-510, Optical Repair Unit, Mobile; and D-511, Tentative Optical Repair Unit, which show tentative construction or installation arrangement of the interior equipment of the mobile optical unit."<sup>59</sup> The Laboratory warned, however, that "Modification of the plans as shown in the drawings will, no doubt, require changes inasmuch as many of the items of equipment to be installed will vary in dimensions from the estimated dimensions upon which all plans and drawings have been made."<sup>60</sup>

The Laboratory was not to wait long, nevertheless, before it could determine just how much modification of its tentative drawings would be necessary, for just at this time The Surgeon General was told that "Information has been received by this office that all of the equipment under procurement will be shipped from commercial manufactures by 27 October 1943," and that each manufacturer had been "requested to make shipments by express in order to expedite delivery."<sup>61</sup> The Laboratory anticipated, furthermore, "that the pilot model

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mobile optical repair unit will be completed ten (10) days after receipt of the equipment to be installed in it."62

Just as had been predicted, on 27 October 1943--three weeks after Headquarters, Army Service Forces, had approved the action establishing military characteristics of the unit and some 2- $\frac{1}{2}$  months after The Surgeon General's Office had authorized purchase of most of the equipment on the open market--the optical equipment that was being procured commercially arrived.<sup>63</sup> Meanwhile the Equipment Laboratory had apparently found inadequate the Medical Department power unit which it had requested three months earlier, for on 29 October it asked The Surgeon General's Office to requisition from the Signal Corps "power unit #PE - 75 - T, 2- $\frac{1}{2}$  KW, inasmuch as the Medical Department had no generator suitable for use with the optical unit."<sup>64</sup>

Nevertheless, by the end of October the Equipment Laboratory was able to report that "With the exception of [the generator and] some power V belts for the motors of the grinding and surfacing machines, all of the equipment which has been under procurement for the mobile optical unit has been received"; that "Preliminary drawings and specifications covering mobile optical unit are now being drafted"; and that "It is anticipated that the unit in question will be completed and ready for road tests on 15 November 1943, and ready for shipment for service testing if desired."<sup>65</sup>

The work of development is recapitulated, in fine, in these cursory words of an officer of the Medical Department Equipment Laboratory:

In November 1943, nearly all of the equipment had been received and the problem of putting in all of the equipment was tackled. Every bit of space available was utilized, drains were hidden beneath table tops so as not to cut down one bit the available working space. The load to be carried by the truck was considerable and this weight had to be distributed so as not to overload in any one spot. The equipment was shuffled and reshuffled placed here and there so that the most feasible plan could be obtained. Finally the unit was finished. . . .<sup>66</sup>

The pilot model of the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Optical Repair Unit was then ready for inspection and tests.

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#### D. Inspection and Tests.

Among other matters on the agenda of the meeting of the Optical Advisory Board as announced for 16 November 1943 was a discussion of "the possibility of omitting operational test of the new mobile optical unit in view of its critical need overseas."<sup>67</sup> Consequently, the completed pilot model having been brought to Washington for inspection on that date, "The general design embodied in the optical repair unit was tentatively approved by representatives of The Surgeon General's Office and by the Optical Advisory Board" and at the same time "Plans were formulated . . . to have an operational test of the unit in question conducted at Carlisle Barracks, Pennsylvania as soon as practicable."<sup>68</sup> And so, on 18 November, the Medical Department Equipment Laboratory was authorized "to hold limited service test for the mobile optical unit at Carlisle and adjacent military installations for production of glasses for period of not over ten days."<sup>69</sup>

Decisions reached during the meeting of the Optical Advisory Board and a comprehensive guide to be followed during conduct of the test were elaborately set forth on 27 November 1943 in a four-page letter from the Chief of the Field Equipment Development Branch to the Director of the Medical Department Equipment Laboratory. This letter indicated that the Optical Advisory Board had accepted the new unit "with considerable enthusiasm"; that inasmuch as "practically the same equipment was being included that had been previously used in other mobile units, a lengthy field operational test would not be required"; but that "a limited operational test should be made in order that any minor deficiencies might be corrected before final specifications are written."<sup>70</sup>

It was proposed, therefore, that the tests be conducted "over a consecutive period of approximately seven days" beginning 30 November by a Captain A. E. Mangold, Sanitary Corps, and six enlisted men who had "recently completed the training course for opticians at the Medical Supply Services School, St. Louis, Missouri."<sup>71</sup> Captain Mangold had apparently been acting as an adviser on Project, F-32 for some time; but he was chosen to perform the test, among other reasons, for his "actual overseas experience in the operation of such units."<sup>72</sup>

As outlined in the comprehensive instructions (See Appendix I), the test was to determine the practicability of the completed unit (1) in stationary operation employing both commercially available electric power and generated current and (2) under simulated mobile field conditions actually involving movement to several locations and the per-

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formance of prescription service. More specifically, studies were to be made to determine the productive capacity of the unit, the number of personnel required to operate with maximum efficiency, advisability of adding or deleting equipment, determination of most suitable size of generator required, adequacy of heating and supply of hot water, effectiveness of operation under blackout, sufficiency of storage space, protection of windows from bomb fragments, and proper placement of equipment within the unit.<sup>73</sup>

It was further recommended that all additional supplies found needful be requisitioned from The Surgeon General's Office "for inclusion with this unit so that 'Pilot Model' will then be complete as to equipment and stock for the purpose of using as a basis of procurement on quantities required, in accordance with completed tentative specifications."<sup>74</sup> Further still, The Surgeon General's Office anticipated, because of limited production facilities available, that certain concessions relative to departure from "specifications written on the Pilot Model" would have to be made to manufacturers "to insure expeditious delivery of completed Mobile Optical Units."<sup>75</sup> For that reason The Surgeon General's Office, explaining that "Your cooperation in this connection will aid in elimination of delivery delays of completed units from suppliers on an item which is urgently needed for overseas theaters of operations," requested that "at some time during the operational test, or before the final specifications are written, this office be advised so that arrangements can be completed with the supplier for one of their engineers to make inspection of such unit."<sup>76</sup>

Apparently anticipating that personal friction might result from detailing an outsider to conduct the field tests for the Medical Department Equipment Laboratory and obviously desiring to obviate any delay that might be so occasioned, The Surgeon General's Office advised the Director of the Laboratory thus:

Captain Mangold has, in view of his broad optical experience as pertains to operation of mobile units overseas, proved a very valuable aid to this office through recommendations made for improvement of the overall optical program. It is, therefore, requested that your office give every consideration to any recommended changes he might make as a result of this operational test, as it is believed that this will result in the final approved Pilot Model meeting all the requirements that will be necessary under actual field operating conditions.<sup>77</sup>

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Reports of the test, together with drawings, specifications, photographs, and recommendations, were to be forwarded to The Surgeon General's Office.<sup>78</sup>

Promptly upon receipt by the Equipment Laboratory of this letter of instructions, the limited operational test was performed. A favorable formal operational test report, signed by Captain Mangold (who indicated that he had been "given complete cooperation by the Medical Department Equipment Laboratory while testing this unit"<sup>79</sup>), was sent to The Surgeon General's Office on 8 December 1943.

This report revealed that in the field with a  $2\frac{1}{2}$  KVA gasoline motor being used, "five minutes were required to set up the optical equipment for operation and 15 minutes were required to service and start operation of the generator," and that "the unit, operated in a warehouse using electric means, was satisfactory in all respects."<sup>80</sup> A maximum of six men (one driver) was needed to achieve a total daily productive capacity of 75 jobs, the  $2\frac{1}{2}$  KVA generator was judged to be the size most desirable, the heating and the supply of hot water were deemed to be adequate, and special protection for windows was considered to be unfeasible. During blackout, the report continued, a light trap could be improvised from a "piece of canvas tent fly or tarpaulin drawn from the Quartermaster or Ordnance."<sup>81</sup>

Also considered were questions relative to adequacy of storage space and to supplementing or eliminating, distributing or locating equipment and supplies within the unit. Among other minor recommendations was one that mechanical guards be required for certain of the more delicate equipment to protect it from damage while the truck is in transit. And as suggested by The Surgeon General's Office, the Medical Department Equipment Laboratory, it was reported, would be "happy to cooperate with manufacturers or suppliers."<sup>82</sup> (For complete text of this report see Appendix J).

Within two weeks after the report of the operational test had been submitted, the Equipment Laboratory completed its revision of drawings and specifications for the Mobile Optical Repair Unit and, on 22 December 1943, forwarded them to The Surgeon General's Office. Additional information about the pilot model and the test to which it had been subjected was included in the letter notifying The Surgeon General's Office that the Laboratory's part in the development was, in effect, complete.

Indicating that construction of the pilot model had been finished on 1 December 1943, for example, the Director of the Medical Department Equipment Laboratory wrote.



3. Tests: The completed Pilot Model Mobile Optical Repair Unit was examined and tested by this office for the following:

- a. Weights: Front and rear axle loads and total gross weight.
- b. Roadability and maneuverability of the loaded vehicle.
- c. Shipping dimensions.
- d. Adequacy of interior equipment.
- e. Generator carrying arrangement.

4. Findings: Inspections and tests reveal the following:

- a. Front axle load (less driver) 3,700 pounds.  
Rear axle load (less driver) 12,000 pounds.  
Total gross weight 16,800 pounds.

b. Roadability and maneuverability of the vehicle was good and all slopes, roads, and grades were negotiated without difficulty. There was no shifting or damage of any of the interior equipment on cross-country travel.

c. Shipping dimensions will be 1603 cu. ft. 160 sq. ft.

d. The interior equipment provided for in the inclosed specification and drawings (drawings are being sent under separate cover) are adequate as shown on the accompanying operational test report and equipment list of Captain Mangold.

e. Generator. — A carrying arrangement for a 2-1/2 KVA generator is included in the interior fittings of the body, by the use of web straps and floor plates, however, if any larger generator is supplied the power unit would have to be mounted on a One Ton Cargo Trailer. A generator smaller than 2-1/2 KVA will not supply sufficient power to operate the unit.<sup>83</sup>

This letter from the Equipment Laboratory concluded with a recommendation that the Mobile Optical Repair Unit "be adopted as a standard equipment by the Medical Department, U. S. Army."<sup>84</sup> Except for formal termination of the project—an action which seems never to have been effected, this recommendation concludes, except for subsequent changes in specifications, subsequently to be discussed, the developmental work on Project F-32.

#### IV. Standardization Phase.

Subsequent to the suggestion of the Director of the Medical Department Equipment Laboratory, action to initiate

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standardization of the new development occurred promptly; for on 29 December 1943 the Chief of the Field Equipment Development Branch of The Surgeon General's Office formally recommended "that the Mobile Optical Repair Unit be standardized by the Medical Department Technical Committee."<sup>85</sup>

Meeting 3 January 1944, then, the Technical Subcommittee recommended that the unit be standardized and in conformity with the provisions of AR 850-25, further proposed that the nomenclature be Truck, 2½-Ton, 6 x 6, Optical Repair Unit; that the old Optical Repair Unit, Mobile, Large (Item 93638) be reclassified as limited standard inasmuch as the new unit would replace it; that responsibility for purchase and inspection of the chassis of the newly developed truck be assigned to the Ordnance Department but that responsibility for the procurement, purchase, inspection, specifications, storage and issue of body, fixtures, and stock equipment be charged to the Medical Department; that the basis of issue be one (1) per Medical Depot Company (T/O 8-661) and one (1) per Optical Repair Team, type 1 (T/O 8-500); and, finally, that the maintenance percentage be approved as follows:

- (1) Zone of Interior --
- (2) Theater of Operations 1.2

The Subcommittee report further indicated that the unit cost would be "\$20,000 including stock or \$14,000 without stock but including fixtures and tools" and that if the recommended basis of issue were approved, requirements for 1944 would be 35 (at a cost of \$700,000) and for 1945 they would be five (at a cost of \$100,000).<sup>86</sup>

The Medical Department Technical Committee, meeting 21 January 1944, approved the report of the Subcommittee with the following modifications, as indicated in a letter of transmittal to the Commanding General, Army Service Forces:

(1) Ordnance Department [to] be charged with responsibility for purchase, specifications, and inspection of chassis and body less installed optical fixtures and equipment, specifications being subject to Medical Department requirements.

(2) Medical Department [to] be charged with responsibility for requirements, funds, storage, and issue of entire item including equipment; and purchase, specifications, installation and inspection of optical fixtures and equipment.<sup>87</sup>

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Headquarters, Army Service Forces, approved without question the recommendations of the Medical Department Technical Committee on 30 January 1944, and all interested agencies within The Surgeon General's Office were promptly notified of this action.<sup>88</sup> Consequently, the Monthly Narrative Report of the Medical Department Equipment Laboratory for January 1944 indicated formally that Development Project, F-32 - Truck, 2½-Ton, 6 x 6, Optical Repair Unit carrying Priority A had been "completed and previously reported"; that the pilot model was, at the request of The Surgeon General's Office, being shipped on 2 February 1944 to the Army Medical Purchasing Office, New York City, and that drawings and specifications covering the unit had already been "forwarded to the Army Medical Purchasing Office on 31 January 1944, for procurement purposes."<sup>89</sup> The report concluded, therefore, with a recommendation "that this project be dropped as its standardization has taken place."<sup>90</sup>

Thanks in very large measure to the foresight and speed manifested in the prior development of the Truck, 2½-Ton, 6 x 6 Surgical as described in Chapter V, development and standardization of the Truck, 2½-Ton, 6 x 6, Optical Repair Unit was likewise remarkably rapid.

On 30 June 1943 The Surgeon General's Office had formally requested Headquarters, Army Service Forces, to approve initiation of the project; by 30 January 1944--just seven months later--standardization had been effected and steps were ready to be taken to get the unit under procurement.

## V. Procurement Phase.

### A. Preliminary Planning to Speed Procurement.

Several days before standardization of Stock No. 9958900, Truck, 2½-Ton, 6 x 6, Optical Repair Unit had been approved by Headquarters, Army Service Forces, The Surgeon General's Office was actively engaged in facilitating procurement of the new unit. On 26 January 1944, for instance, the Supply Planning Division informed the Plans Division of the Operations Service that tentative specifications, equipment lists, and other required data had been "cleared to the Army Medical Purchasing Office, New York, for the purpose of placing this item in procurement to furnish urgent overseas requirements."<sup>91</sup> At the same time it was decided that "Until such time as firm specifications have been written" the pilot model of the Optical Repair Unit should be "made available to the Army Medical Purchasing Office for use as a guide in the completion of the first units delivered from the

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supplier."<sup>92</sup> It was accordingly requested that arrangements be made to have the pilot model transferred for approximately 60 days from the Medical Department Equipment Laboratory to the Army Medical Purchasing Office in New York, at the end of which time it was to be sent on "to the Binghamton Medical Depot for the purpose of re-stocking with supplies packing and crating for overseas shipment."<sup>93</sup>

Standardization of the new optical repair unit having been approved by Army Service Forces on 30 January 1944, only one day elapsed before an order for seven each of the new units was placed with Army Medical Purchasing Office.<sup>94</sup> With delivery of the pilot model to the manufacturer, Krieger Steel Sections, Incorporated, on 3 February 1944,<sup>95</sup> production was ready to begin.

## B. Developmental Difficulties During Procurement.

### 1. Improvising to Utilize Unsatisfactory Basic Vehicles.

Only two serious difficulties related directly to development occurred during the procurement phase and those troubles were rather easily resolved with no very consequential loss of time. A better understanding of the first problem may be gained by reviewing a memorandum of 19 January 1944 from The Surgeon General's Office to the Medical Department Equipment Laboratory--a memorandum written at a time when the Truck, 2½-Ton, 6 x 6, Optical Repair Unit, was still in the process of standardization.

On the subject of Truck, 2½-Ton, 6 x 6, Surgical, this communication pointed out that "considerable difficulty is being experienced in standardizing additional trucks particularly with reference to Ordnance" and that "This confusion could be eliminated if the unit as purchased from Ordnance were the same for all trucks used by the Medical Department."<sup>96</sup> The Surgeon General's Office requested, therefore, that a drawing "be prepared showing the interior and exterior plans and elevation of a truck which could be furnished from the Ordnance Department and be standard with all six trucks now standard or being considered" and, very significantly, "that drawings be prepared showing the additions or modifications necessary for each individual truck."<sup>97</sup> The Surgeon General's Office then proposed a meeting of representatives of the Medical Department Equipment Laboratory, The Office of The Chief of Ordnance, and interested branches in The Surgeon General's Office to determine a definite policy for furnishing the trucks and bodies partly fitted from Ordnance and the remaining specialized fittings for the Medical Department."<sup>98</sup>

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Revision of applicable Medical Department

Equipment Laboratory drawings was accomplished, then, early in 1944<sup>99</sup>—apparently on 29 February and 23 March—in an effort to provide the Medical Department with "a standard truck on which to base all future Mobile Units."<sup>2</sup> The conference proposed for coordinating the problems of supplying the various types of trucks seems meantime to have been held on 1-2 March 1944, for on 24 February The Surgeon General's Office requested the Director of the Laboratory "that an officer from the Medical Department Equipment Laboratory proceed to The Office Chief of Ordnance, Detroit, Michigan, on temporary duty, 1 March 1944, for two (2) days, for the purpose of attending conference on Standardization of Truck, 2½-Ton, 6x6, Medical Department . . . ."<sup>3</sup>

Despite all these efforts to guarantee a supply of appropriate vehicles, the twelve basic bodies being delivered to the manufacturer for conversion into optical repair units--after the first five, which were satisfactory, had been successfully converted--were found, nevertheless, to be grossly deficient in certain fundamental requirements of the optical repair units.

Thus the representative of the Supply Service, Surgeon General's Office, who was most interested in the development of the optical repair truck pointed out in lucid detail on 24 June 1944 the dilemma in which, as a result of this mix-up, the Medical Department found itself. He indicated that his office had just learned through the Army Medical Purchasing Office that specifications for the Truck, 2½-Ton, 6 x 6, Optical Repair Unit had been "revised under date of 23 March 1944, in a manner which makes various changes both in the basic unit and in the installation of optical equipment."<sup>4</sup> Some of the changes resulted in an unsuitable arrangement of edgers (which tended to make the area around the sink more congested when the unit was in operation); unsatisfactory re-arrangement of the vertical water tank (which deprived the unit of 18 or 20 inches of badly needed counter space); and an undesirable reorganization of the sink assembly (which relocated on the right, instead of the left, the cab net standing on the sink counter) - an innovation which made any use of the cabinet by the spindle operator extremely unhandy.<sup>5</sup>

More important, however, than these changes which, though "definitely undesirable from the standpoint of the optical repair unit, can perhaps be accepted if the changes are vital to the efficiency and over-all adaptability of the basic unit" was "the elimination of the two lens cabinets which fitted beneath the sink counter"—cabinets which "represent 25% of the lens storage space and are vital to the unit."<sup>6</sup> It was suggested, therefore, that

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permitting the sink drain to be elbowed either to the right or to the left somewhat as shown in the original layout would permit these two lens cabinets to be included provided the built-in cabinet with shelves as shown in the revised drawing is eliminated in the basic unit intended for use as optical repair units. An extra board would have to be added to the sink counter which has been reduced in depth; otherwise, the lens cabinets would protrude perhaps four or five inches. It is recommended that the Ordnance Department be authorized to make the necessary changes in the sink drain, sink counter and sink cabinet as suggested for the optical repair units if such changes do not lend themselves to the basic unit generally.<sup>7</sup>

In support of the suggestion that special handling might be accorded the alterations necessary for the optical repair units, it was reported that

equipment assemblies for all 19 of these units were purchased early this year after standardization of the unit, but before the revisions referred to. The two lens cabinets intended to fit under the sink in each unit are all on hand, and it is understood that the contractor has purchased sink assemblies for these units in accordance with the original specifications which means that if we are forced to accept the current changes, the contractor will revise his quotations upwards, and we will pay more for an unsatisfactory unit deficient in badly needed cabinet space.<sup>8</sup>

In reply, the Director of the Technical Division on 14 July 1944 concurred with the observation that "the changes made definitely limit the proper operation of the Optical Repair Unit," but he did not "recommend any change in the standard Medical Department vehicle as obtained from the Ordnance Department."<sup>9</sup> Instead, he wrote (but without explanation as to the discrepancy in the number of units required):

Reference to twelve (12) additional vehicles required at this time, it is recommended that the cabinet and counter at the front of the truck be removed and a new counter the proper width of the sink properly located and with the required cabinets mounted below be substituted. Any change in piping to properly

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locate the sink and the hot water tank should be made. Edgers should be relocated, also the cabinet standing on the sink counter. In general, this work would have as its object as close a duplication of the original five (5) models as is possible for the maximum use of the materials on hand.<sup>10</sup>

Contract for the alterations, if the recommendations of the Technical Division were followed, was to be placed by the Army Medical Purchasing Office. And it was stated, finally, that "The design of the present truck with its accompanying specification will be referred back to the Medical Department Equipment Laboratory for change to include this work on any future requirements for Optical Repair Units."<sup>11</sup>

The Supply Service, Surgeon General's Office, thereupon promptly recommended to the Army Medical Purchasing Office that the recommendations of the Technical Division for remodeling of the basic trucks "be carried out as expeditiously and economically as possible through separate contract with Krieger by the Army Medical Purchasing Office."<sup>12</sup> And a day later the Surgeon General's Office, transmitting to him copies of the correspondence which has just been reviewed, explained to the Director of the Medical Department Equipment Laboratory that

Inasmuch as the seventeen units, which include the five original models and the twelve being procured at this time will in all probability serve the needs of the Army for the duration, it is thought that the changes recommended will actually not reflect a great expenditure of funds and in any event, it is thought that the adoption and use of the standard Medical Truck for this unit is worth the expenses involved to effect a satisfactory design for the Optical Repair Unit.<sup>13</sup>

Although the Equipment Laboratory was accordingly requested "for any future procurement of this item" to change the drawings and specifications in accordance with suggestions made in certain correspondence that was inclosed, The Surgeon General's Office did observe that "Since action has already been taken by the AMPO to make changes in the twelve trucks now under construction, this project need not carry an urgent priority."<sup>14</sup>

And so, by its immediate decision for prompt, positive action to rectify by special contract the first of the difficulties of procurement that were directly related to development, the Army Medical Department successfully

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relieved itself of a dilemma, the two alternatives of which were manifest: namely, (1) to accept a substitute that could have been made to serve the purpose of the desired optical repair unit but that would have been, in operating efficiency, vastly inferior to it; or (2) to abide a dangerous, not to say vexing, delay while delivery of urgently needed trucks that did possess the necessary characteristics was being awaited. The expedient of converting the trucks on hand by means of a special contract was action no more expeditious than rational.

2. Acceptance of Units at Variance with Specifications.

The second of the two serious difficulties of procurement that were related to development seems possibly to have resulted from the same cause as the first--the failure to complete with sufficient promptness adequate and firm specifications for the Optical Repair Unit.

From the beginning, one will recall, the Medical Department proceeded apace with procurement despite the fact that specifications for the unit had not been finally drafted. At first the developmental pilot model had served also as a procurement model and as such became in practice, one might say, a virtual purchase description. Later the tentative specifications formally submitted by the Army Medical Purchasing Office received from The Surgeon General's Office approval "as a purchase description only, to be used until such time as modified suggested specifications incorporating the basic Medical Truck are completed."<sup>15</sup> Although the Equipment Laboratory had revised certain of its drawings on 16 August 1944 and had proposed on 1 September an amendment to its Tentative Specification No. 100-B, The Surgeon General's Office took about two months to instruct the Army Medical Purchasing Office in part as follows:

Since there are additional changes to be made in the specification, it is believed that instead of preparing an amendment, based on the inclosed Amendment No. 1 /dated 1 September 1944/ from the Medical Department Equipment Laboratory, the specification should be revised. In the opinion of this office the requirements appearing in the inclosed amendment should be added . . . to read as follows . . . :

"Prior to installing the sink cabinet, work surface, sink and piping, covered by Drawings D-510 and B-545, the contractor shall remove sink and sink cabinet as set up in the basic truck."<sup>16</sup>

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Thus it appears that even in late October 1944, nine months after the item had been standardized, the truck housing the Optical Repair Unit was still so susceptible to change--possibly both through design and through accident--that drafting formally acceptable specifications for it was either difficult or unwise so long as the Medical Department was undecided as to just what its intent relative to the Optical Repair Unit really was.

It would not be difficult to believe from such manifest evidence that the confusion in procurement might easily have resulted from the absence of firm specifications for the truck, 2½-Ton, 6 x 6, Optical Repair Unit; but it is probably more likely that the real cause of the mix-up to be discussed directly lay at least partially in another and more personal reason.

At the request of the Army Medical Purchasing Office a representative of the Medical Department Equipment Laboratory had gone to New York

to examine a production model Truck, 2½Ton, 6x6, Optical Repair Unit with particular reference to certain changes in the truck interior equipment which were accepted by the Optical Branch of the Army Medical Purchasing Office, New York, and which were at variance with the applicable Medical Department Equipment Laboratory Drawings.<sup>17</sup>

A detailed report of this inspection, which revealed twenty-odd departures from the technical requirements specified in the Equipment Laboratory drawings, was submitted to The Surgeon General on 6 January 1945.<sup>18</sup> The complete text of this report is presented as Appendix K; but its detailed observations may be more briefly categorized as follows:

1. Relocation of certain cabinets, interior fittings, and operational equipment, the necessity of which resulted, in some instances, from structural changes that were themselves unauthorized by applicable specifications.

2. Structural changes in certain interior fittings, notably blackout shades, various storage compartments, locking bars on cabinets, hot water tank, auxiliary piping connections, and the sink drain pipe.

3. Substitution of structural materials and finish of table top.

4. Installation of additional drawers, storage

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boxes, and a bolt and block device for securing the bowl of the lens surfer. "As the Medical Department Equipment Laboratory Drawings applicable to the Truck, 2½ Ton, 6 x 6, Optical Repair Unit have been standardized as now drawn," the report concluded, "disposition of this project is requested."<sup>19</sup>

Shortly after this report reached The Surgeon General's Office the Director of the Technical Division referred it to the Chief of the Ophthalmology Branch with the request "that changes accomplished which are desirable in the standard item be indicated in order that standard drawings may be revised accordingly" and with the suggestion "that Capt. A.E. Mangold indicate the desirable changes on applicable standard drawings and forward same as an inclosure for clarification."<sup>20</sup> This suggestion accordingly was transmitted by the Chief of Supply Service, Surgeon General's Office, to the Army Medical Purchasing Office on 19 January 1945.<sup>21</sup>

In reply to this suggestion of The Surgeon General's Office came a report from the Army Medical Purchasing Office dictated by Captain Mangold<sup>22</sup> and dated 2 March 1945. Although it considered individually each of the discrepancies noted by the inspector from the Equipment Laboratory, most of its comments justifying acceptance of these discrepancies were extremely superficial. Four of them, for example, stated identically that "This change should be made for the more efficient operation of optical equipment"; another reasoned that "This change should be made so that handle of surfer is in correct working position"; a third, that "Additions that were added to the interior of the truck are necessary for more efficient operation of unit as a whole," and others were almost equally as vague.<sup>23</sup> Captain Mangold concluded his report--the text of which, for ease of comparison with that of the inspector from the Medical Department Equipment Laboratory, is presented as Appendix L--with the suggestion that "before the new blueprints of basic truck and equipment for the mobile optical repair unit be standardized... this office [Army Medical Purchasing Office] have the opportunity of checking them."<sup>24</sup>

The changes recommended in this report of Captain Mangold were concurred in by the Ophthalmology Branch of The Surgeon General's Office and

the Medical Department Equipment Laboratory was instructed to revise MDELTS #100-B and drawings on the Optical Repair Unit, to conform with changes of construction of the interior equipment. These changes

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conform to drawings delivered to the M.D.E.L. by the Krieger Steel Sections Inc., Long Island City, N.Y., at the request of Army Medical Purchasing Office.<sup>25</sup>

In accordance with the instructions, then, the "Medical Department Equipment Laboratory patiently revised the drawings and specifications," as an officer of the Equipment Laboratory phrased it in his historical account of Developmental Project, F-32, "and forwarded them to the Surgeon General on 4 April 1945."<sup>26</sup>

Officer personnel of the Medical Department Equipment Laboratory make no effort to hide their chagrin over the preëmption of their function by Captain Mangold and the contractors outfitting the optical repair units. Thus the officer submitting the narrative of the role played by the Medical Department Equipment Laboratory in the development of the Truck, 2½-Ton, 6 x 6, Optical Repair Unit Remarks:

The reversal of the testing officer's [Captain Mangold's] opinion is the amazing part of this story. When he tested the unit at Carlisle everything was perfect even the changes that he found in the service test were corrected, the truck was standardized yet nearly a year and a half later he was changing the design to suit his and the manufacturer's fancy irregardless [sic] of liaison standard drawings and specifications. It makes one wonder who was really handling such things in the Medical Department.<sup>27</sup>

And the Equipment Laboratory, as will be seen in a moment when an attempt to evaluate the project is made, had legitimate cause for complaint.

### C. Statistical Summary of Procurement.

Of all the new optical repair units procured by the Medical Department, just how many were affected by this last revision of specifications is not immediately apparent. The original order of 1 February 1944 called for seven each of the units, of which two were delivered on 15 May, two on 31 May, and the remaining three on 15 June 1944. Obviously then, since the revisions just discussed had by that time not even been suggested, trucks delivered on the original order were not involved in the changes. Be as it may the effect of this late revision of specifications and

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drawings, nevertheless, by 31 October 1945--two and a half months after the end of active hostilities on all fronts--orders had been placed for a total of 24 units, all of which by that date had been delivered. Since 13 each of the old Optical Repair Unit, Mobile (Stock No. 9363800) had been furnished during 1942 and 1943, the Army Medical Purchasing Office procured a grand total of 37 mobile repair units--of both the old and new types--during the period of World War II, for which the Medical Department paid, at the unit cost of \$20,481.01, more than three-quarter million dollars.<sup>28</sup>

## VI. Evaluation.

### A. The Item.

When he appreciates the unheralded importance of the Army's program to supply the optical needs of the 18 percent of its personnel who required spectacles during the recent war; when he reflects upon the utter chaos of the optical supply that existed during the early days of the conflict; when he considers how much was contributed to that chaos by the variety of equipment and supplies contained in the old mobile optical repair unit despite the most cooperative and assiduous efforts of the optical industry and of The Surgeon General's Office to make the original unit effective; when he takes due cognizance of the contribution unquestionably made by the newly developed unit in helping to rectify the chaos, a rectification so efficacious that by the time the European campaign ended the adequacy of the Medical Department's optical facilities was precluding the necessity of evacuating, in the European theater at least, some 10,000 troops each month--then the historian of Development Project, F-32, Truck, 2½-Ton, 6 x 6, Optical Repair Unit finds himself accepting as completely plausible the judgment of the author of the History of the Optical Program that "for all practical purposes, this unit worked out splendidly" and that in the master program "the equipment used and the units devised were completely adequate to do the job for which they had been developed."<sup>29</sup>

Thus it may reasonably be concluded that notwithstanding the high cost (\$20,481.01 as against \$9,000 for the next most costly of all the Medical Department's specialized truck-units, the Truck, 2½-Ton, 6x6, Dental Operating<sup>30</sup>), the money, time, and labor spent in developing and procuring the new mobile optical repair units was labor, time, and money well spent. The unit was, among other things, of pecuniary value in that it aided materially in preserving the effective strength of personnel committed to action. Since comparatively few of these units were required, furthermore, the gross cost to the Medical Department was not really prohibitive.<sup>31</sup>

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The unit developed under Project F-32 (see Figures 29 and 30) had several very decided advantages over the old mobile optical repair unit, which had been so generously developed by the optical industry and which the new unit was to replace. Whereas the old was mounted on a  $2\frac{1}{2}$ -Ton truck with stake body covered by a tarpaulin, the new unit with its custom-built body was completely self-contained and had heat, water, and light—improvements which enabled operations to be performed within the truck under adverse weather or blackout conditions. The equipment of the new unit "for all practical purposes was identical to the old unit, with the exception that surfacing equipment was added because it was found that a large stock of lenses supplied with the old unit could fill only 90% to 95% of all prescriptions."<sup>32</sup> When the optical repair unit was designed, furthermore,

it was decided that all equipment, i.e., the surfacing and edging equipment, would be permanently mounted on the benches which were in turn permanently mounted on the floor of the body; later it was found that it would be more ideal to make the equipment removable since occasionally, these units would operate behind the rear lines, and the ideal conditions would be to remove the equipment and operate in some building.<sup>33</sup>

In making the equipment demountable, then, the Medical Department was complying with the letter of the expressed wish of Headquarters, Army Service Forces; nevertheless the spirit of the action was different, for Army Service Forces had wanted the equipment made demountable merely to facilitate shipment of the item overseas.

In other ways the directive of Headquarters, Army Service Forces, however—the directive that was so at variance, as we have seen, with another directive on the same subject but relative to a different mobile unit: the directive that the Truck,  $2\frac{1}{2}$ -Ton, 6 x 6, Optical Repair Unit be designed as a knock down type of vehicle—never reached fruition in the finished product. This directive, indeed—with not so much as an acknowledgment or a non-concurrence appearing in the records—seems to have been completely ignored throughout. Nor was it ever followed up by Headquarters, Army Service Forces, who may either have been informally apprised of the untenableness of its position or have discovered it for itself and may then have decided to let sleeping dogs lie. Since the desire underlying this directive, too, was principally to facilitate packing for overseas shipment, it is probable that neither compliance nor non-compliance with it by the Office of The Surgeon General would affect the operating efficiency of the mobile optical repair unit as finally developed.

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B. Administration of Project.

An evaluation of the administration of Project F-32 falls rather naturally into two parts: (1) the procedural aspects and (2) the difficulties encountered in engineering and procurement. Although the second of these divisions overlaps slightly with the first, it is sufficiently independent to justify a separate discussion.

1. Procedural Aspects.

At first, one may recall, the initiation of Development Project, F-32 was handled partly formally, partly informally by The Surgeon General's Office and Headquarters, Army Service Forces. Since the requirement overseas for mobile optical repair units was rapidly becoming acute and since long delays in delivery were logically to be expected as a result of the prevalent critical shortage of optical equipment and supplies, any device to expedite the project was greatly to be applauded. In the unconventional procedure that was employed, however, two very gross infractions of the provisions of AR 850-25 occurred: (1) no statement of military characteristics for the proposed vehicle was offered and none was demanded; (2) the recommendation to initiate the project formally passed through neither the Subcommittee nor the Medical Department Technical Committee.

Within five weeks, nevertheless, The Surgeon General's Office discovered its oversight, promptly and properly processed the statement of military characteristics through both the Subcommittee and the Medical Department Technical Committee, and again received the approval of Headquarters, Army Service Forces, just about three months after that office had initially approved the project. But with all this formality in rectifying oversights in procedure, the work of development proceeded without delay.

Once the Truck, 2½-Ton, 6 x 6, Optical Repair Unit had been developed, no delay was occasioned, either, in its standardization. Only one month elapsed between the recommendation and the approval of the action classifying the newly developed unit as a standard Medical Department item. Thanks to the planning that had earlier permitted development of the Surgical Truck into a basic Medical Department all-purpose body, only seven months elapsed, furthermore, between formal initiation of the development project and standardization of the developed item.



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2. Engineering and Procurement.

No evidence has been discovered to explain why the twelve basic trucks that were unsatisfactory for conversion as they were into optical repair units should ever have been delivered to the manufacturer. A possible explanation lies in the fact that, concurrent with this delivery, specifications for the basic body were being drafted and that proper coordination of the proposed specifications among the interested agencies may not have been accomplished with sufficient care. But whatever the cause of the difficulty, The Surgeon General's Office intervened promptly and therewith effectively solved the problem by having the desired alterations performed under separate contract. For taking such decisive action and for taking it so quickly, The Surgeon General's Office deserves only praise.

The second problem of engineering and procurement--the controversy, though hardly an articulate one, between the Medical Department Equipment Laboratory and Captain Mangold--was more definitely a result of maladministration. In arbitrarily recommending and accepting changes in specifications that related to the construction and location of certain fittings and equipment of the optical repair unit without so much as coordinating these changes with the Medical Department Equipment Laboratory, Captain Mangold was unceremoniously preempting the functions of the Equipment Laboratory. Since he apparently acted upon his own authority, there is little wonder that officers of the Laboratory were wondering just who within the Medical Department was handling the development of field equipment.

The strictures against Captain Mangold, nevertheless, appear not completely justified. The Surgeon General, by implication at least, had given him broad responsibility when Captain Mangold, because of his overseas experience, was assigned to conduct at the Medical Department Equipment Laboratory the operational test of the pilot model. Perhaps the absence of subsequent counter-directives was interpreted as giving him carte blanche authority to continue his developmental activities even after the operational test had been completed, the specifications and drawings approved, and the truck adopted as standard. Or it is remotely possible, on the other hand, that he was unacquainted with the accepted procedure by which changes in specifications are ordinarily handled--that is, by careful coordination with the Equipment Laboratory and with all interested agencies within The Surgeon General's Office.

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Neither does the historian consider Captain Mangold's reversal of opinion as nefarious a trick as some would picture it. Only seven days, one will recall, had been allowed for the operational test; and even if that were sufficient for doing a thorough job, the testing officer should still be accorded the privilege after further reflection of changing his mind as to the most efficient arrangement of interior fittings and equipment, even if the rearrangement were at variance with what he had previously deemed satisfactory. If these observations are correct, it then seems that Captain Mangold is to be praised rather than blamed for having the intellectual honesty to admit that certain of his original recommendations were erroneous and to propose his amended opinions as a substitute. Only the manner in which he effected the proposed changes---only his presentation to the Medical Department of a fait accompli, appears to an unbiased observer as a justifiable grounds for criticism.

Since machinery did exist for obtaining legitimately the results which Captain Mangold desired, no one can condone him for having usurped the functions of others. But regardless of the irregularity of his actions and notwithstanding the apparent superficiality of his reasons for desiring the changes that he accepted, The Surgeon General's Office apparently still trusted his experienced judgment; for although the patience of personnel at the Medical Department Equipment Laboratory may have been taxed to change all their drawings and specifications to bring them into accord with Captain Mangold's latest recommendations, the recommendations that he made were in the end accepted.

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FOOTNOTES TO CHAPTER, VIII

<sup>1</sup>Report of Mr. Stanley W. Rybak, Optical and Artificial Eyes Sec., Distribution Div., Supply Service, to Hist. Div., S.G.O., 28 Dec. 1945; subject: "History of Optical Program," p. 4 (Hist. Div., S.G.O. 400.16-1). Hereafter referred to as Rybak's Report.

<sup>2</sup>Memo. to Chf., Finance Br., Finance and Supply Div., fr. Capt. D. A. Peters, 24 Dec. 1941; subject: "Mobile Optical Unit," p. 1. (Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).

<sup>3</sup>Rybak's Report, p. 2.

<sup>4</sup>Ibid.

<sup>5</sup>See n. 2, above.

<sup>6</sup>Ibid.

<sup>7</sup>Ibid., pp. 1-2.

<sup>8</sup>Ibid., p. 2.

<sup>9</sup>Ibid.; et passim.

<sup>10</sup>Ibid.; p. 3; et passim.

<sup>11</sup>Memo. to Maj. Griffin, fr. Capt. D. A. Peters, 24 Dec. 1941, Supplement A as Incl. 1 (Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).

The unit cost of the truck finally standardized was \$20,481.01. (See p. 471, infra, and footnote 28, Note 1, p. 484.)

<sup>12</sup>See n. 2, above, p. 3, passim.

<sup>13</sup>Memo to Maj. Gardner, fr. Capt. D. A. Peters, 22 Jan. 1942 (Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).

<sup>14</sup>See n. 2, above, p. 4.

<sup>15</sup>See, for example, correspondence relating to this project in the files of the Optical and Artificial Eyes Section, Distribution Division, Supply Service Service, S.G.O.

An interesting sidelight on the characteristic cooperation of industry in this project is reflected in the fact that the American Optical Company even forwarded

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to The Surgeon General's Office, apparently gratuitously, a partial list of "American Optical Company Personnel who are in military service" and promised that since this was only a partial list, "more will follow later." (Ltr. to Capt. Peters, C/O S.G.O., fr. American Optical Company, 6 Jan. 1942; Re: - "Personnel, Mobile Optical Replacement Unit" (Optical and Artificial Eyes Sec., Distribution Div., Supply Service, S.G.O.).

It was apparently contemplated, then, that former employees of American Optical Company would be used to man the mobile optical repair units.

<sup>16</sup>Rybak's Report, p. 2; et passim.

<sup>17</sup>Memo. to Dir., Professional Service, fr. Senior Consultant in Ophthalmology, Office of the Chief Surgeon, ETO, 28 Oct. 1942; subject: "Optical Equipment and Supplies" (A.M.R. & D. Bd.).

<sup>18</sup>Ltr. to T.S.G., fr. Senior Consultant in Ophthalmology, Office of the Chief Surgeon, ETO, 28 Nov. 1942; subject: "Summary of suggested plan for the Solution of the 'Spectacle' problem, for the Military forces as a whole" (A.M.R. & D. Bd.).

<sup>19</sup>Ibid.

<sup>20</sup>Memo. to Lt. Col. T. N. Page fr. Chf., Optical Br., S.G.O. 24 Dec. 1942 (A.M.R. & D. Bd.).

<sup>21</sup>Memo. to Plans Div., Field Equipment Br., fr. Chf., Specialties Br., 4 Jun. 1943 (A.M.R. & D. Bd.).

<sup>22</sup>See "Medical Department's Estimate of the Situation," pp. 444-446, supra.

<sup>23</sup>Ltr. to C.G., A.S.F., fr. Research Coordination Br., S.G.O., 30 Jun. 1943; subject: "Optical Unit, Mobile - Development Project on" (A.M.R. & D. Bd.).

<sup>24</sup>1st Ind. to Dir., M.D.E.L., fr. Chf., Specialties Br., S.G.O., 13 Jul 1943; basic: ltr. to Dir., Specialties and Supply Planning Div., S.G.O., fr. Dir., M.D.E.L., 7 Jul. 1943; subject: "Optical Unit, Mobile" (A.M.R. & D. Bd.).

<sup>25</sup>"Program of Meeting to be held at Office of The Surgeon General at 2:00 P.M., Tuesday, 22 Jan. 1943, to discuss matters pertaining to the Optical and Orthopedic Programs", 22 Jan. 1943. (A.M.R. & D. Bd.).

<sup>26</sup>Memo. to Chf., Research Coordination Br., Plans Div., fr. Chf., Field Equipment and Development Br., Plans Div., 25

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Jun. 1943; subject: "Research Project for the Revision of the Mobile Optical Unit" (A.M.R. & D. Bd.).

27 Ibid.; et passim.

28 See n. 23, p. 477.

29 1st Ind. to T.S.G., fr. Dir., Requirements Div., Hq., A.S.F., 5 Jul. 1943; basic: see n. 23, p. 477 (A.M.R. & D. Bd.).

30 2d Ind. to C.G., A.S.F., fr. Research Coordination Br., Plans Div., 6 Jul. 1943; basic: see n. 23, p. 477 (A.M.R. & D. Bd.).

31 Ibid.

32 3rd Ind. to T.S.G. fr. Chf., Development Br., Requirements Div., Hq., A.S.F., 10 Jul. 1943; basic: see n. 23, p. 477 (A.M.R. & D. Bd.).

33 See pp. 326-329, supra.

34 See n. 32, above.

35 Cf. document cited in n. 32, above, with 7th Ind. to T.S.G. fr. Chf., Development Br., Requirements Div., Hq., A.S.F., 27 Apr. 1943; basic: ltr. to T.C.G., Hq., Armored Force, Ft. Knox, Ky., fr. S.G.O., 22 Mar. 1943; subject: "Truck; 2 1/2-Ton, 6 x 6, Surgical" (A.M.R. & D. Bd.).

36 Memo. to Field Equipment Br., Plans Div.; Fiscal Div.; Chf., Optical Br., Supply Planning and Specialties Div., fr. Research Coordination Br., 13 Jul. 1943; subject: "Optical Unit, Mobile - Development Project on" (A.M.R. & D. Bd.).

37 Memo. to Field Equipment Development Br., fr. Research Coordination Br., 1 Jul. 1943; subject: "Optical Unit, Mobile" (A.M.R. & D. Bd.).

38 Memo. to Dir., M.D.E.L., fr. S.G.O., 3 Jul. 1943; subject: "Optical Unit, Mobile" (A.M.R. & D. Bd.).

39 Ltr. to Dir., Specialties and Supply Planning Div., fr. Dir., M.D.E.L., 7 Jul. 1943; subject: "Optical Unit, Mobile"; et passim. (A.M.R. & D. Bd.).

40 Ibid.

The Director, Medical Department Equipment Laboratory had not yet been notified - formally, at least - of the increased allotment of funds.

- 41 1st Ind. to Dir., M.D.E.L., fr. Chf., Specialties Br., S.G.O., 13 Jul. 1943; basic: see n. 39, p. 478 (A.M.R. & D. Bd.).
- 42 Ibid.
- 43 Monthly Narrative Report, M.D.E.L., 1 - 31 Jul. 1943, p. 20 (A.M.R. & D. Bd.).
- 44 Monthly Progress Report to The Surgeon General on Research and Development Projects, 13 Aug. 1943, SECRET (Rec. Rm., S.G.O. 451.2). Extracted in clear.
- 45 Ltr. to T.S.G., fr. M.D.E.L., 31 Jul. 1943; subject: "Equipment for Mobile Optical Unit (F-32), and Surgical Truck, Operating (F-35)" (A.M.R. & D. Bd.).
- 46 Ltr. to C.G., Carlisle Bks., Pa., fr. Chf., Specialties Br., 2 Aug. 1943; subject: "Optical Repair Equipment on Surgical Truck" (A.M.R. & D. Bd.).
- 47 Ltr. to M.D.E.L., fr. Specialties and Supply Planning Div., S.G.O., 10 Aug. 1943; subject: "Optical Repair Unit, Mobile" (A.M.R. & D. Bd.).
- 48 Monthly Narrative Report, M.D.E.L., 1 - 31 Aug. 1943, p. 16 (A.M.R. & D. Bd.).
- 49 See memo to Chf., Research Coordination Br., fr. Chf., Specialties Br., 5 Aug. 1943; subject: "Revision of Optical Repair Unit, Mobile" (A.M.R. & D. Bd.).
- 50 See ltr. to Chf., Field Equipment Development Br., fr. Secy., M.D.T.C., 9 Aug. 1943; subject: "Military Characteristics of Mobile Optical Repair Unit", with Incl. and 1st Memo. Incl. (A.M.R. & D. Bd.).
- 51 Rpt. to Subcommittee on Field Equipment to M.D.T.C., 23 Aug. 1943; subject: "Optical Repair Unit, Mobile" (A.M.R. & D. Bd.).
- 52 Memo. fr. Secy., M.D.T.C., 6 Sep. 1943; subject: "Optical Repair Unit, Mobile" (A.M.R. & D. Bd.).
- 53 Ltr. to C.G., A.S.F., fr. Chf., Operations Service, S.G.O., 13 Sep. 1943; subject: "Truck, 2 1/2-Ton, 6 x 6, Optical Repair Unit" (A.M.R. & D. Bd.).
- 54 1st Ind. to C.G., A.S.F., fr. Hq., A.S.F., 22 Sep. 1943; basic: see n. 53 above (A.M.R. & D. Bd.).
- 55 3rd Ind. to T.S.G., fr. Hq., A.S.F., 7 Oct. 1943; basic: see n. 53, above (A.M.R. & D. Bd.).



<sup>56</sup>Memo. to Chf., Field Equipment Development Br., and Chf., Optical Br., Procurement Div., fr. Research Coordination Br., 12 Oct. 1943; subject: "Truck, 2½-Ton, 6 x 6, Optical Repair Unit." (A.M.R. & D. Bd.).

<sup>57</sup>Ltr. to [T.S.G.], fr. Capt. G.T. Kellogg, Asst., M.D.E.L., 4 Dec. 1945; subject: "Truck, 2½, Optical Repair Unit, Project F-32 and Truck, 2½, 6 x 6, Dental Operating, Project F-37, Histories of," Incl. 1, p. 1 (Hist. Div., S.G.O.).

<sup>58</sup>Monthly Narrative Report, M.D.E.L., 1 - 30 Sep. 1943, p. 16 (A.M.R. & D. Bd.).

<sup>59</sup>Ltr. to T.S.G. fr. M.D.E.L., 23 Oct. 1943; subject: "Mobile Optical Repair Unit" (A.M.R. & D. Bd.).

<sup>60</sup>Ibid.

<sup>61</sup>Ibid.; et passim.

<sup>62</sup>Ibid.

<sup>63</sup>Ltr. to [T.S.G.], fr. Capt. G.T. Kellogg, Asst., M.D.E.L., 4 Dec. 1945; subject: "Truck, 2½, Optical Repair Unit, Project F-32 and Truck, 2½, 6 x 6, Dental Operating, Project F-37, Histories of," Incl. 1, p. 6. (Hist. Div., S.G.O.).

<sup>64</sup>Ibid.

<sup>65</sup>Monthly Narrative Report, M.D.E.L., 1 - 31 Oct. 1943, p. 16; et passim (A.M.R. & D. Bd.).

<sup>66</sup>See n. 63, above.

<sup>67</sup>Notice of Optical Advisory Board Meeting, 16 Nov. 1943, p. 2, appended to ltr. to Dir., M.D.E.L., fr. John B. Klopp, Asst. [S.G.O.], 18 Nov. 1943; subject: "Mobile Optical Unit" (A.M.R. & D. Bd.).

<sup>68</sup>Monthly Narrative Report, M.D.E.L., 1 - 30 Nov. 1943, p. 10 (A.M.R. & D. Bd.).

<sup>69</sup>Ltr. to M.D.E.L., fr. S.G.O., 18 Nov. 1943; subject: "Mobile Optical Unit" (A.M.R. & D. Bd.).

<sup>70</sup>Ltr. to T.C.G., Carlisle Bks., Pa., fr. Chf., Field Equipment Development Br., S.G.O., 27 Nov. 1943; subject: "Operational Test of Mobile Optical Repair Unit as Developed at Carlisle Barracks" (A.M.R. & D. Bd.).

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<sup>71</sup>Ibid.; et passim.

<sup>72</sup>Ibid.

<sup>73</sup>Ibid.

<sup>74</sup>Ibid.

<sup>75</sup>Ibid.; et passim.

<sup>76</sup>Ibid., et passim.

<sup>77</sup>Ibid.

<sup>78</sup>Monthly Narrative Report, M.D.E.L., 1 - 30 Nov. 1943; p. 10. (A.M.R. & D. Bd.).

<sup>79</sup>Ltr. to Dir., Supply and Planning Div., S.G.O., fr. Aurel E. Mangold, Capt., Sn. C., 8 Dec. 1943; subject: "Operational Test of the Mobile Optical Repair Unit developed by the Medical Department Equipment Laboratory" (Optical and Artificial Eyes Sec., Distribution Div., Supply Service, S.G.O.).

<sup>80</sup>Ibid.; et passim

<sup>81</sup>Ibid.

<sup>82</sup>Ibid.

<sup>83</sup>Ltr. to T.S.G., fr. Dir., M.D.E.L., 22 Dec. 1943; subject: "Mobile Optical Repair Unit" (A.M.R. & D. Bd.).

<sup>84</sup>Ibid.

<sup>85</sup>Memo. to Chairman, M.D.T.C., fr. Chf., Field Equipment Development Br., 29 Dec. 1943; subject: "Mobile Optical Repair Unit" (A.M.R. & D. Bd.).

<sup>86</sup>Medical Department Technical Subcommittee Report on: Truck, 2½-Ton, 6 x 6, Optical Repair Unit to The Med. Dept. Tech. Comm., 7 Jan. 1944 (A.M.R. & D. Bd.).  
Although this report (Par. 2) indicates that the Subcommittee met on 3 January 1943, the date 1943 is obviously a typographical error for 1944.

<sup>87</sup>Ltr. to C.G., A.S.F., fr. Chf., Operational Service, S.G.O. 21 Jan. 1944; subject: "Truck, 2½-Ton, 6 x 6, Optical Repair Unit" (A.M.R. & D. Bd.).

<sup>88</sup>Memo. to Chf., Supply Service; Dir., Procurement Liaison Br., A.M.P.O.; Chf., Field Equipment Development Br.,

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Plans Div.; Chf., Organization and Equipment Allowance Br.,  
Plans Div.; Fiscal Div (IN TURN), fr: Research Coordination  
Br., S.G.O., 2 Feb. 1944; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6,  
Optical Repair Unit; and see, also, memo. to Chf., Supply  
Service; Dir., Fiscal Div., Chf., Development Br.,  
Technical Div.; Dir., Training Div. (IN TURN), fr. Research  
Coordination Br., S.G.O., 7 Feb. 1944; subject: "Truck,  
2 $\frac{1}{2}$ -Ton, 6 x 6, Optical Repair Unit" (A.M.R. & D. Bd.).

89 Monthly Narrative Report, M.D.E.L., 1 - 31 Jan. 1944, p.  
10 (A.M.R. & D. Bd.).

90 Ibid.

91 Memo. to Plans Div., Operations Service, S.G.O., fr.  
Supply Planning Div., 26 Jan. 1944; subject: "Pilot Model  
2 $\frac{1}{2}$ -Ton, 6 x 6, Optical Repair Unit" (M.D.E.L.).

92 Ibid.

93 Ibid.; and cf. passim.

94 1st Ind. to Lt. Richard E. Yates, S.G.O., fr. Maj. A.  
Hornbacher, M.A.C., Historian [A.M.P.O.], 31 Oct. 1945;  
basic: ltr. to Maj. Arthur Hornbacher, A.M.P.O., fr.  
Richard E. Yates, 1st Lt., M.A.C., 22 Oct. 1945 (Hist.  
Div., S.G.O.).

95 Ltr. to [T.S.G.], fr. Capt. G.T. Kellogg, Asst., M.D.E.L.,  
4 Dec. 1945; subject: "Truck, 2 $\frac{1}{2}$ ; Optical Repair Unit,  
Project F-32 and Truck, 2 $\frac{1}{2}$ , 6 x 6, Dental Operating,  
Project F-37, Histories of," Incl. 1, p. 16. (Hist. Div.,  
S.G.O.).

96 Memo. to Dir., M.D.E.L.; fr. John B. Klopp, Lt. Col. M.C.,  
Asst. [S.G.O.], 19 Jan. 1944; subject: "Truck 2 $\frac{1}{2}$ -Ton 6 x 6,  
Surgical" (A.M.R. & D. Bd.).

97 Ibid.

98 Ibid.

99 See n. 95, above.

1 Memo. to Chf., Technical Div., fr. Lt. Col. W. H. Potter,  
Asst. [Supply Service, S.G.O.], 24 Jun. 1944; subject:  
"Specifications for Truck, 2 $\frac{1}{2}$  Ton, 6 x 6 Optical Repair,  
Item No. 99589" (Rec. Rm., S.G.O. 451.2-1).

2 See n. 95, above.

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- <sup>3</sup>Ltr. to Dir., M.D.E.L., fr. Col. R. G. Prentiss, Jr., Asst., [S.G.O.], 24 Feb. 1944; subject: "Request for Representation at Conference" (A.M.R. & D. Bd.).
- <sup>4</sup>See n. 1, p. 482.
- <sup>5</sup>Ibid.
- <sup>6</sup>Ibid.; et passim.
- <sup>7</sup>Ibid.
- <sup>8</sup>Ibid.
- <sup>9</sup>1st Memo. Ind. to Chf., Supply Service, S.G.O., fr. Dir., Technical Div., 14 Jul. 1944; basic: see n. 1, p. 482. (Rec. Rm., S.G.O. 451.2-1).
- <sup>10</sup>Ibid.
- <sup>11</sup>Ibid.
- <sup>12</sup>2d Memo. Ind. to C.O., A.M.P.O., fr. Exec. Office, Supply Service, 18 Jul. 1944; basic: see n. 1, p. 482. (Rec. Rm., S.G.O. 451.2-1).
- <sup>13</sup>Memo. to Dir., M.D.E.L., fr. Chf., Operations Service, S.G.O., 19 Jul. 1944; subject: "Specifications for Truck, 2½-Ton, 6 x 6, Optical Repair Item No. 99589" (Rec. Rm., S.G.O. 451.2 Carlisle Bks.-N).
- <sup>14</sup>Ibid.; et passim.
- <sup>15</sup>Memo. to Supply Coordination Br., fr. Chf., Development Br., 18 Mar. 1944; subject: "M.D.T.S. No. 1697, Truck, 2½-Ton, 6 x 6, Optical Repair Unit" (A.M.R. & D. Bd.).
- <sup>16</sup>Ltr. to C.G., A.M.P.O., fr. Chf., Operations Service, S.G.O., 24 Oct. 1944; subject: "Medical Department Tentative Specification No. 1697-A" (A.M.R. & D. Bd.).
- <sup>17</sup>Ltr. to T.S.G. fr. Dir., M.D.E.L., 6 Jan. 1945; subject: "Inspection of Truck, 2½ Ton, 6 x 6, Optical Repair Unit" (Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).
- <sup>18</sup>Ibid.
- <sup>19</sup>Ibid.; see Appendix K.
- <sup>20</sup>Memo. to Chf., Ophthalmology Br., fr. Dir., Technical Div., 12 Jan. 1945; subject: "Truck, 2½-Ton, 6 x 6,

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Optical Repair Unit" (Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).

<sup>21</sup>1st Memo. Ind. to C.O., A.M.P.O., fr. Chf., Supply Service, 19 Jan. 1945; basic: see n. 20, p. 483 (Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).

<sup>22</sup>Ltr. to T.S.G., fr. Capt. G. T. Kellogg, Asst., M.D.E.L., 4 Dec. 1945; subject: "Truck, 2½, Optical Repair Unit, Project F-32 and Truck, 2½, 6 x 6, Dental Operating, Project F-37, Histories of," Incl. 1, p. 22 (Hist. Div., S.G.O.).

<sup>23</sup>Ltr. to S.G.O., fr. A.M.P.O., 2 Mar. 1945; subject: "Changes in Basic, 2½ Ton, 6 x 6, Med. Dept. Truck" (M.D.E.L.).

<sup>24</sup>Ibid.

<sup>25</sup>Memo. to Chf., Supply Coordination Br., fr. Acting Chf., Development Br., 14 Apr. 1945; subject: "Truck, 2½-Ton, 6 x 6, Optical Repair Unit" (A.M.R. & D. Bd.).

<sup>26</sup>See n. 22, above.

<sup>27</sup>Ibid., p. 23.

<sup>28</sup>1st Ind., to Lt. Richard E. Yates, S.G.O., fr. Maj. A. Hornbacher, Historian A.M.P.O., 31 Oct. 1945; basic: ltr. to Major Arthur Hornbacher, A.M.P.O., fr. Lt. Richard E. Yates, 22 Oct. 1945 (Hist. Div., S.G.O.).

Note 1: The unit cost, as given in "Errata Sheet," Army Service Forces Catalog MED-3 (1 Mar. 1944), is only \$20,000. The figures given above, furthermore, apparently do not reflect procurement of those optical equipment assemblies (estimated approximate cost, \$3500) designated as base shop optical units, "comprised of essentially the same equipment and supplies as contained in the Truck, 2½-Ton 6 x 6, Optical Repair Unit but without the carrier," which could be furnished "to areas where mobility is not essential." (Memo. to Distribution and Requirements Div., Units." - Optical and Artificial Eyes Sec., Distribution Div., S.G.O.).

Note 2: Although he overestimated the number of units in service, the historian of the optical program furnishes the following information that throws an interesting side-light upon overseas operation of the unit: "The mobile optical repair units ordinarily operated behind the rear lines, and only in a few exceptional cases were in the forward areas or went forward with the initial invasion forces. Of the approximately fifty mobile units in over-

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seas theaters, only one was destroyed by German aircraft which raided our rear lines." (Rybak's Report, p. 36).

<sup>29</sup> Rybak's Report, p. 27; et passim.

<sup>30</sup> See n. 28, p. 484.

<sup>31</sup> Against a total of 24 orders and deliveries each of the optical repair units stands a total of 77 orders and deliveries each of the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Laboratory, Medical - its nearest competitor for low honors numerically. The unit cost of the medical laboratory, however, exclusive of truck and body, was only \$824. (See n. 28, p. 484).

<sup>32</sup> Rybak's Report, p. 31.

In deciding to add surfacing equipment to the facilities of the mobile optical repair units the Surgeon General's Office was really reverting to a possibility proposed by rejected for what appeared very valid reasons when consideration was first given to the development of a mobile optical repair unit back in 1941-42. For discussion of this rejection, see "Medical Department's Estimate of the Situation," pp. 444-446, supra.

<sup>33</sup> Rybak's Report, pp. 31-32.

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## CHAPTER IX

### THE MOBILE DENTAL OPERATING UNIT

#### I. Introduction.

##### A. The Dental Ambulance (1917-1919).<sup>1</sup>

The problem of supplying professional dental care to small troops units, widely scattered and lacking attached dental personnel, was not unique to World War II. It was encountered by both American and French forces in France during the early months of World War I, and soon led to official recognition of the need for some type of "mobile dental clinic": a unit which, when fully equipped, would be capable of travelling under its own power from one outlying station to another, remaining at each post only long enough to provide adequate emergency service for the command.

A special "dental ambulance"--a conversion of the standard Red Cross ambulance--was accordingly designed, and plans were made to have a number of these new units produced as quickly as possible. Contributions were raised in the United States for eleven such vehicles and, as soon as constructed, these units were shipped to the East coast to await transportation overseas. Unfortunately, due to a lack of shipping facilities, the new ambulances remained for many months at a home port of embarkation. Despite numerous letters and cables from overseas units urging immediate shipment of the dental ambulances to France, the war ended before any of these vehicles had reached our expeditionary forces.

Two dental ambulances were, however, presented in France to the dental service. One, donated by two American dentists, had come originally from the American Red Cross hospital at Mailly. After being thoroughly overhauled and re-equipped, it was finally placed in operation, with a dental officer in charge, on 1 November 1917, and was designated "Dental Ambulance No. 1, AEF." Assigned to a motor division located some distance back of the line, this vehicle continued to operate during the entire period of hostilities, its station assignment being with one or another of the several units of the motor transport corps in the vicinity of Mailly.

A second dental ambulance was presented to the dental corps by the American Red Cross through its medical director in Paris. This vehicle was delivered about 1 March 1918, and was designated "Dental Ambulance No. 2, AEF." Its

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station assignment was with the Air Service of the advance section, with headquarters near Colombe la Belle, and its first location at the second bombardment airdrome. Throughout the entire subsequent period of the war, this vehicle rendered service to the several small detached stations adjacent to Headquarters, Air Service.

B. Peacetime Status of the Dental Ambulance (1919-1941).

While, due to the overseas shipping bottleneck, only two dental ambulances ever saw service with the American Expeditionary Forces, the performance of these units was evidently impressive. In the Annual Report of The Surgeon General for the year 1919, specific reference was made to these vehicles and the scope and usefulness of their activities were described in some detail.<sup>2</sup> It was pointed out, moreover, that the demand for mobile dental operating units by United States troops in France had been far in excess of the token number actually supplied.

The need for dental ambulances--mobile dental offices--has been indicated many times during the campaign. The use of dental ambulances with outlying commands; or with small detachments within divisional training areas; or located in the rear of combat sectors, or with Air Service, would have proven of great value, inasmuch as these mobile units could proceed to the various locations, with little loss of time, either in actual transport or in the unpacking and repacking of equipment ordinarily required of dental officers on itinerant service.<sup>3</sup>

In view of the above observations, made immediately after the close of the war on the basis of actual combat experience, it might have seemed that inclusion of the dental ambulance as a permanent and standard adjunct of the field dental service would have followed as a matter of course. This, however, was not the case. Although a board of three dental officers was appointed in 1919, to take advantage of the experience gained during the campaign, it does not appear that the development or standardization of mobile dental operating units was included among the board's suggested revisions of dental equipment and supplies.<sup>4</sup> This initial opportunity lost, it was never thereafter regained. From 1920 to 1941, its funds drastically curtailed, the Medical Department was forced to confine its research and development activities in the field of dental operating equipment to improvement of the Medical Department.

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Chest #60 and periodic revision of its contents.<sup>5</sup>

The closest approach to a mobile dental service--though they bore little resemblance to the specially designed dental ambulances of World War I--were the travelling dental units developed in the thirties by the Medical Department to solve the problem of providing adequate dental service to the widely scattered work units of the Civilian Conservation Corps. On the recommendation of The Surgeon General the essentials of the new system were given War Department sanction on 3 December 1936. An organization of travelling dental teams was established, each team consisting of a dental reserve officer and two assisting enrollees, all to be transported by truck, with suitable operating equipment, for short periods of dental service at successive work camps.<sup>6</sup> However, inasmuch as these trucks were essentially cargo vehicles rather than self-contained operating units, the World War I concept of a dental ambulance was still far from being revived.

## II. Initiation of Development Project, F-39.

### A. Project Proposal No. 1.

Six months after our entry into World War II, official action was at last taken to consider development of the type of dental vehicle which had been so strongly recommended in 1919. On 29 May 1942, in a communication addressed to the Research and Development Division of The Surgeon General's Office, the Dental Service requested establishment of a formal research project to produce a genuinely self-contained mobile dental operating unit. As evidence of the existence of a military requirement for the item, it was pointed out that the Air Corps had already requested that three of these new units be supplied as quickly as possible.<sup>7</sup>

This additional dental facility was necessary, it was explained, for the following reasons:

a. To furnish a more adequate dental service to small detachments not entitled to a dental officer by Tables of Organization, especially those doing guard duty and small Air Corps units in the zone of the Interior.

b. This Unit could be used to advantage in certain Theater of Operation but it is not intended for use in the combat zone.

c. Dental treatment could be brought to

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small detachments thereby minimizing the time lost from military duties.<sup>8</sup>

Then followed a brief statement of military characteristics for the proposed item: (1) the unit should be mounted on a standard chassis; (2) it should provide shelter for the operator and for the patient undergoing treatment; (3) dental equipment and supplies should be installed in cabinets which could be easily removed in the event that the truck became unserviceable; (4) storage cabinets should be so located as to provide convenient accessibility to the dental operator of all necessary instruments; (5) suitable lighting facilities should be provided for night operations; (6) unit equipment should include facilities for casting and soldering operations.<sup>9</sup>

The foregoing project proposal did not, it will be seen, represent the strongest possible case that could have been made for the development of a mobile dental operating unit. No reference was made to the World War I precedent for such a unit, or to the early official advocacy of the dental ambulance as set forth in The Annual Report of The Surgeon General for the year 1919. Moreover, while the immediate usefulness of the proposed mobile unit as a Zone of the Interior facility was stressed, the potential overseas demand for such an item was accorded only secondary consideration. In view of the fact that in the months to follow the most persistent demand for dental operating vehicles was to come from the North African Theater rather than from Zone of the Interior installations, and in view of the additional fact that overseas need was a crucial factor both in the evaluation of project proposals and in the assignment of research priorities--the emphasis selected in the above instance was doubly unfortunate.

The ultimate rejection of this particular project request can, of course, scarcely be attributed to the single fact that the Dental Service had not phrased its formal proposal as convincingly as it might have. Behind this was the basic question as to whether a firm military requirement for the proposed vehicle did in fact exist. That question, as we shall see, was decided finally in the negative.

On 20 May 1942, the Chief of the Research and Development Division forwarded the Dental Service's project application to the Medical Department Subcommittee with the following comment:

It appears that the military characteristics of the unit have been formulated satisfactorily.



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It is not thought that any serious difficulty would be encountered in designing a unit to serve the purpose mentioned, but there may be some question of whether it would have a sufficiently wide range of utility to justify its standardization.<sup>10</sup>

With the above communication, the documentary history of this first attempt at project initiation comes virtually to an end. Suffice it to say that the Dental Service's request was not approved.<sup>11</sup> As there is no record that the case of the mobile dental operating unit ever reached the Medical Department Technical Committee for discussion,<sup>12</sup> the presumption is that it was allowed to die in subcommittee. The only written indication of the specific reasons for this final rejection is a pencilled notation placed in the record by the Chief of the Research Coordination Branch. This states that the subject project was disapproved by the Deputy Surgeon General, on the ground that there was no military requirement for the item in the Zone of the Interior.<sup>13</sup>

This decision to forego initiation of Development Project, F-39, made by the Medical Department in the early summer of 1942, was based upon the facts as they existed at that time. As time passed, however, these facts were to change. Before the close of 1942, an urgent need for dental operating vehicles was reported by the Twelfth Air Force in North Africa, and in the months that followed this unit stated that demand had grown to a point where improvisation would no longer suffice.<sup>14</sup> During 1943 and 1944, the experience of these dental officers in the North African Theater began to be approximated in other active theaters, notably in Italy and in the South Pacific.<sup>15</sup> Finally, by November, 1944, as a result of increases in the number of small detachments and prisoner-of-war camps in the United States, even Service Command requirements for mobile dental operating units had risen substantially.<sup>16</sup>

Whether, without hindsight, the Medical Department might possibly have anticipated this subsequent rise in demand for dental operating trucks is, of course, impossible to determine at this distance from the event. It can only be said in passing that failure to establish a development project in the summer of 1942 led ultimately to a number of difficulties which might otherwise have been avoided. As it happened even the necessary capital would have been available at this earlier date--and from sources outside the Government. In November, 1942, \$18,000 was made available to the Medical Department by the Dental Gold Manufacturers for the express purpose of assembling four

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mobile dental operating units at Carlisle Barracks, Pennsylvania. However, since the Dental Service's request for development of this item had already been disapproved, the above offer was not favorably considered. Instead, the money was diverted to development of a mobile dental laboratory, for which a formal Medical Department research project had just been established.<sup>17</sup>

B. The Improvised Mobile Dental Laboratory.

The impetus behind this second attempt to secure Medical Department approval of a dental operating truck project was supplied by dental personnel of the Twelfth Air Force, stationed in Northwest Africa. Impressed with the urgent need for some type of self-contained dental operating vehicle which could bring regular dental service to the many small and widely dispersed Air Force units in that theater, the dental staff at Headquarters, Twelfth Air Force, wrote in May 1943 to The Surgeon in Washington, stressing the great desirability of having mobile dental operating units in North Africa.<sup>18</sup> While awaiting official action in the matter, the dental staff, in cooperation with a local Ordnance section, immediately began experimenting with various types of simple conversions, involving standard Ordnance vehicles. Finally, after some weeks of work, a somewhat crude but practicable mobile operating unit was devised by mounting essential dental equipment on a small arms Ordnance repair truck. The improvisation was tried out by the 560th Signal Air Warning Battalion, then located in Northwest Africa and, after a fairly extensive service test, was approved as satisfactory.<sup>19</sup>

Photographs of the new unit, together with descriptive data, were thereupon forwarded by Headquarters, Twelfth Air Force, to The Surgeon General's Office, and this action was followed by a cablegram to the Ordnance Department in Washington, requesting that an Ordnance Small Arms Repair Truck be demonstrated to The Air Surgeon as a conversion possibility.<sup>20</sup> Neither of these actions, as we shall see, was sufficient in itself to convince higher authority of the existence of a genuinely widespread need for dental operating trucks. Thus far, it should be observed, the demand had come entirely from a single source.

Accordingly, no action was taken by The Surgeon General's Office with regard to the first communication. As for the cablegram, while it fared somewhat better, the end-result was the same. The action copy of the cablegram was handled by an Ordnance liaison officer on duty at Headquarters, Army Air Forces. He immediately notified Air Corps officials that a small arms repair truck

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would be made available for inspection at nearby Bolling Field whenever desired. When informed of the background of the proposed mobile dental unit and its previous disapproval by the Medical Department, he indicated that he would answer the cablegram to the effect that "the Office of The Surgeon General would be notified of the recommendation for consideration of this truck for such purpose, if and when a Mobile Unit was authorized."<sup>21</sup>

The promised notification of The Surgeon General's Office was duly undertaken shortly thereafter by Headquarters, Army Air Forces. A one-page memorandum, summarizing the above cable request and Ordnance's intended reply, was prepared and forwarded to the Dental Division of The Surgeon General's Office on 30 July 1943. In concluding this resume report, Army Air Forces added these lines:

It appears from Major Lightner's report as well as a detailed personal description from Brigadier General Eugene G. Reinartz (M.C.), who recently returned from a trip to North Africa and while there observed the improvised Mobile Dental Ambulance in operation, that this type of truck is very desirable for this purpose.

It is recommended that the project of a Mobile Dental Outfit be again presented for approval when considered appropriate.<sup>22</sup>

Although, thus far, it had signally failed to accomplish its objective, the Twelfth Air Force nevertheless continued its campaign. On 10 September 1943, a letter was sent direct to The Air Surgeon requesting shipment of twenty-four small arms Ordnance repair trucks to the North African Theater for conversion into mobile dental operating units. The mounting and installation of dental facilities would be accomplished, it was explained, within the theater.<sup>23</sup> Two days later another letter was sent to The Air Surgeon, this time requesting incorporation of the Truck, 2½ Ton, Ordnance Maintenance (less Ordnance equipment) into the Tables of Basic Allowance of ten specified Air Corps units. Approval for this change was requested at the earliest practicable moment.<sup>24</sup>

These two written requests, each highly specific and strongly stated, yielded tangible results at last. Forwarded by The Air Surgeon's Office to the Office of The Surgeon General on 11 October 1943,<sup>25</sup> they elicited a week later the following reply from the latter agency:

2. Attempts to secure a truck as a Mobile Dental Operating Unit have been

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unsuccessful.

3. It is believed that the Truck, 2½-Tony, 6X6, (4dt) Ordnance Maintenance, L. W. B. is satisfactory as an improvisation of a Mobile Dental Operating Unit but heavier than required.

4. It is recommended that special requisition for twenty-four (24) Small Arms Ordnance Repair Trucks be initiated by the Theater involved.<sup>26</sup>

Although the Table of Basic Allowance recommendation had been passed over, a special requisition for additional Ordnance vehicles was now authorized. The Twelfth Air Force was finally getting results.

#### C. The Establishment of an Air Service Command Development Project.

Members of the dental staff of the Twelfth Air Force had been campaigning for six months, by this time, to secure recognition of the dental operating vehicle as necessary basic equipment for Air Force units in overseas theaters. With the battle now half won by the special allocation of twenty-four Ordnance trucks to the North African Theater for conversion into dental operating units, the issue was soon pushed one logical step further. On 1 November 1943, over the signature of Major Lee M. Lightner, Dental Corps, Office of The Air Surgeon, Headquarters Twelfth Air Force, the following new action was initiated:

1. The need for a mobile dental unit has been quite apparent in this theater for some time for the air force organizations.

2. Experimentation has been done with the mobile dental unit mounted on a small arms ordnance repair truck, pictures of which are inclosed.

3. This mobile unit constructed with salvaged material has been quite satisfactory and a decided improvement over the present field dental equipment.

4. It is requested that further experimentation be done at the Aero Medical Laboratory and that several units be



developed for this theater. Service test reports could and would be submitted within two months from the time of receipt of the mobile dental units.

5. The mobile dental unit pictured in the attached photographs has made it possible for its dental surgeon to perform 50 per cent more work than would otherwise have been done.<sup>27</sup>

In short, improvisation alone would not continue to suffice. What was desired was a more long-range program looking toward eventual standardization and regularized distribution of a mobile dental operating unit. Since The Surgeon General's Office still declined to sponsor the necessary experimental groundwork, request was now being made of the Air Corps itself to assume this developmental responsibility. The service testing function was to be delegated to the Twelfth Air Force, and thus at no point would the assistance of the Medical Department be required.

Forwarded promptly through channels, the above proposal was not long in receiving effective implementation. On 1 December 1943, the Chief of the Ordnance Aircraft Service, Army Air Forces Materiel Command addressed a request to the Commanding General, Air Service Command, that three 2½-ton 6X6, Ordnance maintenance trucks, less load, be procured for immediate shipment to Wright Field, Dayton, Ohio. The vehicles, it was explained, were to be used in the development of experimental mobile dental units. Each truck was to contain a complete dental office, fully equipped to render efficient dental service in the field. The three pilot models would be completed as rapidly as possible, service tested, and then shipped immediately to overseas commands.<sup>28</sup>

On 2 December 1943, this request was approved by Headquarters, Air Service Command and was forwarded for action to the Commanding General, Army Service Forces.<sup>29</sup> Before the middle of December, Ordnance Department had received instructions to procure and ship to Wright Field three small arms repair trucks as specified.<sup>30</sup>

#### Dental Project Proposal No. 2 (Medical Department).

As might be expected it was not long before news of the above activities came to the attention of the Dental Division of The Surgeon General's Office.<sup>31</sup> Almost immediately that office went into action. On 18 December 1943—just sixteen days after approval of the Air Service

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Command project--the Dental Division re-introduced its petition (rejected a year and a half earlier) for the establishment of a Medical Department project to develop a mobile dental operating unit.<sup>32</sup>

Viewed as an alternative to continued Air Force activities in this field, the above project proposal had, of course, much to recommend it. There were a number of very valid reasons why, if this experimental work was now definitely to be undertaken, the Medical Department rather than the Air Service Command should assume full control.

In the first place, the proposed mobile dental operating unit was not an item of equipment peculiar to Army Air Forces, but was an item of Service-wide applicability. It could (and subsequently did) serve all types of small isolated troop units lacking assigned dental personnel--whether those units happened to be elements of the Air Forces, Service Forces, or Ground Forces. Hence, according to the principles of project allocation set forth in AR 850-25, which delegated to Army Service Forces, the responsibility for development of all items of equipment except those "of primary interest to the Army Air Forces,"<sup>33</sup> the Medical Department rather than the Air Service Command was the proper development authority in the present instance.

In the second place, the mobile dental operating unit proposed by the Dental Division was designed to fit into a complete and integrated Medical Department vehicle program, in which the newly standardized surgical truck was to serve as basic model. This latter vehicle consisted, it will be recalled, of a special Medical Department van body, with appropriate interior fittings, mounted on the chassis of a 2½-ton, 6X6, Ordnance cargo truck. The model selected for experimentation by the Air Service Command, however, was a 2½-ton, 6X6 Ordnance small arms repair truck, the body of which had six windows on each side instead of two as prescribed in Medical Department specifications and was six inches wider and one foot shorter than that of the standard surgical truck.<sup>34</sup> Clearly, the adoption of such a vehicle would be a serious obstacle to the attainment of the maximum uniformity of design and maximum interchangeability of parts which was now being planned for all mobile medical units.

In view of these as well as other considerations, it was evident that the Dental Division, from a purely strategic standpoint, had chosen an extremely opportune time to re-introduce its project proposal. There were now not only, as indicated above, serious dangers in further inaction on the part of the Medical Department, but there was, in addition, the growing rivalry between the Air

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Surgeon's Office and the Office of The Surgeon General to tempt the latter into positive action. Also, however slight the demand for dental operating vehicles might have been in May 1942, when the project was first rejected, that demand had now increased appreciably. Finally, there was additional hope in the fact that the new Surgeon General, who had taken office in June 1943, was felt to be especially sympathetic toward the idea of a more motorized dental service.<sup>35</sup>

All of these justifications of Medical Department action were, of course, valid only if this action was to be taken as an alternative to, and not a duplication of, Army Air Forces experimentation. However--and this was an extremely serious omission--no reference whatever was made in the Dental Division's present memorandum, to the paralled experimentation which was currently about to be set in operation by the Air Service Command.

It was simply pointed out by the Dental Division that numerous requests for these mobile units had recently been received from Theaters of Operations, and that the need for a service of this character for small detachments and training areas in the Zone of the Interior had also become quite evident. In view of this definite demand, it was recommended that a research project be initiated immediately to produce a vehicle possessing the following military characteristics:

a. The unit to utilize the standard surgical truck chassis and body.

b. The unit to be equipped and stocked with standard items from the Medical Supply Catalog except for utilities so that general dental operative procedures can be accomplished to include fillings, extractions, and the taking of impressions.

c. The unit to be self sustaining from the standpoint of light, heat, and power.

d. The equipment to be securely installed but capable of being removed.<sup>36</sup>

On 21 December 1943, except for recommending an increase in research funds from \$5,000 to \$10,000, the Medical Department Technical Subcommittee approved without change or addition the project request of the Dental Division.<sup>37</sup> Six days later, the report of the Subcommittee was approved without modification by the Medical Department Technical Committee--with a representative of the Air Surgeon's

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Office present and concurring.<sup>38</sup> By this action of its own liaison officer, Army Air Forces was joining the Medical Department in endorsing what was, in effect, an exact duplication of its own recently launched research undertaking.

On 30 December 1943, with the approval of The Surgeon General, all the foregoing documents were forwarded to the Commanding General, Army Service Forces, with the request that the recommendations contained therein be approved.<sup>39</sup> On 6 January 1944, the Development Branch of the Requirements Division, Headquarters, Army Service Forces,--the same office which three weeks before had cleared Air Service Command's request for authority to procure three Ordnance repair trucks for conversion into pilot model mobile dental operating vehicles<sup>40</sup>--approved the Medical Department's request without comment.<sup>41</sup>

### III. Development Phase.

#### A. The Army Air Forces Controversy.

During January, 1944, the issue of Medical Department versus Army Air Forces experimentation was at last brought out into the open, and for a brief period it appeared that duplication of research effort might be eliminated after all.

On 30 December 1943, in a communication addressed to The Surgeon General, the Air Surgeon's Office stated that it was contemplated that the Aero Medical Laboratory at Wright Field would establish fifty mobile dental operating units during the early part of 1944, and that, accordingly, requisitions for equipment would be submitted to The Surgeon General's Office from time to time, depending upon the procurement of the trucks in which this equipment was to be installed. A detailed equipment list was attached to facilitate future shipments.<sup>42</sup>

In short, as soon as a satisfactory conversion had been worked out, the Air Service Command's initial experimental order for three small arms Ordnance repair trucks was to be followed by what would, in effect, be a production order for an additional fifty vehicles. This was, of course, an entirely logical proposal. Army Air Forces had been officially authorized to initiate a development project to produce a mobile dental operating unit. Once a pilot model had been constructed, service tested, and approved, the placing of a quantity purchase order adequate to meet Air Force needs was the natural next step in the process.

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The fact, however, that this ambitious program was running directly counter to the Medical Department's own intended efforts in this field, was now clearly recognized by the Requirements Division, Army Service Forces, through whose hands the above document next passed. In a first indorsement to the Air Forces Communication, Requirements Division called the attention of The Surgeon General's Office to the fact that Headquarters, Army Service Forces, had, just two days earlier, classified the dental operating truck as an Experimental Medical Department item.<sup>43</sup> An explanation of this apparent duplication was evidently in order.

With the issue thus clearly drawn, action was soon forthcoming. On 10 January 1944, at a meeting of the Medical Department Technical Subcommittee, the problem of inter-Service duplication of research in this particular field was discussed at some length. It was pointed out by representatives of The Surgeon General's Office that the Medical Department had already initiated a project aimed at the development of an item identical in purpose to that proposed in this latest Air Force communication. Apparently not electing to make an issue of the fact that, strictly speaking, the Air Force project had antedated that of the Medical Department by more than a month, the representative of Headquarters, Army Air Forces was quoted as stating that the existence of this Medical Department project had not been known at the time the communication in question had been prepared, and that "the Army Air Forces would be agreeable to awaiting development of a standard Mobile Dental Unit."<sup>44</sup>

This understanding--that Army Air Forces would drop further consideration of the activity proposed in its last communication--was forthwith conveyed by The Surgeon General's Office, through the Commanding General, Army Service Forces, to the Commanding General, Army Air Forces.<sup>45</sup> Inasmuch as no record has been found of any further correspondence on this subject either from Army Service Forces or Army Air Forces, it is presumed that the arrangement described above was accepted by all concerned.

A careful reading of these proceedings will disclose that actually, little had been accomplished by the 10 January meeting with respect to the elimination of dual research. The Army Air Forces had not agreed to discontinue full scale experimentation at the Aero Medical Laboratory with the three Ordnance trucks already on order. It had merely agreed to postpone the requisitioning or outfitting of any additional vehicles pending development of a standard mobile dental unit. It was nowhere stated, moreover, that the "standard Mobile Dental Unit" might not be an Air Force development just as well as a Medical Department development.

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In short, so far only the danger of a duplication of final production orders had been averted.

B. Liaison with Army Air Forces.

Even though no assurances had been obtained from Army Air Forces that it would discontinue its independent investigation of mobile dental operating units, the Medical Department nevertheless went ahead with plans to invite the Air Forces to send a representative to Carlisle Barracks for on-the-spot consultation and liaison with Equipment Laboratory officials. In its letter to the Commanding General, Army Air Forces, reporting the results of the 10 January conference, The Surgeon General's Office added this final paragraph:

The Medical Department development project, "Truck 2 $\frac{1}{2}$ -ton 6X6 Dental Operating Unit" will be carried on at the Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania. Its supervision will be joint by the Dental Division and the Field Equipment Development Branch, Plans Division of this office. In addition cooperation by a dental representative of the Office of The Air Surgeon, Headquarters, Army Air Forces will be welcomed.<sup>46</sup>

On 22 January 1944, Army Air Forces replied that it would be pleased to detail a representative to Carlisle Barracks for temporary duty, and requested information as to when such a trip might be made.<sup>47</sup> The Surgeon General's Office, concurring with the above, informed the Equipment Laboratory that a representative of the Aero Medical Laboratory, who had done considerable work with mobile dental operating units at Wright Field, would attend development of the Medical Department's pilot model.<sup>48</sup> The necessary coordinating action was taken in due course, with the result that an Air Force liaison office was present at the Equipment Laboratory throughout the greater part of the construction period.<sup>49</sup>

This inter-Service cooperation, despite the continuance of paralled experimentation, at least paved the way toward a more willing acceptance by Army Air Forces of the Medical Department's final product.

C. Construction of the Dental Operating Truck.

Inasmuch as the standard surgical truck had been specifically prescribed as the model to be used in the present conversion, and since the conversion work itself

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would be governed to a considerable extent by the structural patterns already established by the Army medical laboratory and mobile dental laboratory developments, there was little need in this situation for a lengthy preliminary investigation of all possible research alternatives. There was, however, in the files of The Surgeon General's Office certain background information with which research and development personnel were familiar, and which, at least in one instance was to prove useful in the subject project.

The Research and Development Division, for example, had requested and received photographs of the 3-ton Dental Lorry being used by the Canadian Army.<sup>50</sup> The Director of the Dental Division had obtained a description of two mobile dental units developed in England during the early part of 1943 by United States Forces--these units consisting of 32-passenger, diesel power motor buses, equipped with dental chairs, dental units, and X-ray facilities, and supplied with individual power plants transported via trailer.<sup>51</sup> But most important of all, officials both of The Surgeon General's Office and of the Equipment Laboratory were thoroughly familiar with the Ordnance repair truck conversions which had been performed by the Twelfth Air Force in North Africa. Actually, the Medical Department had, itself, participated in that experimentation to the extent of furnishing The Air Surgeon's Office with a detailed equipment list for the unit.<sup>52</sup> As we shall see, this previous assembly of an equipment list did much to expedite the selection of dental items to go into the new Medical Department truck.

On 12 January 1944, the Research and Development Division of The Surgeon General's Office notified the Director of the Medical Department Equipment Laboratory that the initiation of a research project for a mobile dental operating unit had been approved by Headquarters, Army Service Forces, and that \$10,000 had been authorized for the development work. In addition, the communication contained an especially clear statement of the division of responsibility which was to obtain during the course of the project. The Dental Division, it was explained, was charged with the preparation of a complete equipment list, a copy of which would be sent to the Laboratory as soon as it was finished. The specified equipment would then be requisitioned by the Research and Development Division for direct shipment to Carlisle Barracks. Request had already been made for authority to purchase one 2½-ton, 6X6, surgical truck and, as soon as this vehicle was received by the Equipment Laboratory, it was desired that conversion work be begun.<sup>53</sup>

Here was central policy control at its best. All major duties had been precisely allocated. There was no

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residual overlapping of function. Moreover, considering the liaison arrangements with Army Air Forces which had already been worked out, close inter-Service coordination was assured. Finally, care had been taken to avoid the lengthy delays that had been encountered in previous projects as a result of decentralized purchasing procedures. In the present instance, instead of delegating this function to the Equipment Laboratory, a Class IV installation, all supplies and equipment were to be centrally requisitioned by the Research and Development Division of The Surgeon General's Office.

These several measures set the tone for the project. As will soon become evident, it was no accident that the dental operating truck was completed in the record time of 45 days.

Having already thought through the problem of equipping a mobile dental operating unit--both in connection with its previous project proposal of May, 1942, and later in response to The Air Surgeon's request for an equipment list which might be used by the Twelfth Air Force in its experimental work--the Dental Division had little difficulty in revising these earlier lists to meet current requirements. Accordingly, on 14 January 1944, just eight days after approval of the subject project, a four-page equipment list was forwarded by the Dental Division to the Director of the Equipment Laboratory at Carlisle. In the accompanying letter of transmittal, attention was called to the fact that certain additions and deletions suggested by the Laboratory and by the Air Force liaison representative had been made in preparing the attached list. Except for the possible substitution of a Signal Corps generator for the Medical Department power unit now specified, there being some question as to whether the latter unit could produce the amount of electricity required, no further revisions of significance were anticipated.<sup>54</sup>

The Director of the Medical Department Equipment Laboratory, apparently having already learned of the discussion regarding the Signal Corps versus the Medical Department generator, lost no time in expressing a preference. On 14 January 1944 the same day the above communication was mailed, the Laboratory sent a letter to The Surgeon General's Office requesting that a Signal Corps power unit be selected for installation in the experimental dental truck, and also that this item be centrally requisitioned in order to save time.<sup>55</sup>

Prompt and energetic action on this proposal was taken the following day, The Surgeon General's Office addressing a request to the Requirements Division, Army

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Service Forces, that authority to purchase a Signal Corps generator be granted the Medical Department at the earliest date practicable. It was explained that the item was needed immediately for experimental purposes.<sup>56</sup> The decided note of urgency which had been injected into the above letter produced results. Within a week a reply had been received from Army Service Forces, approving the purchase request and authorizing direct communication with the Chief Signal Officer in order to expedite procurement.<sup>57</sup> Before the close of the month, the power unit had arrived at Carlisle Barracks.<sup>58</sup>

Authorization for the purchase of an experimental vehicle having by this time been obtained, on 19 January 1944, the Equipment Laboratory requested the Commanding General, Carlisle Barracks, Pennsylvania, to requisition one surgical truck from the Army Service Forces Depot at Richmond, Virginia.<sup>59</sup> Five days later, the truck was delivered to the Equipment Laboratory, whereupon construction work was immediately begun.<sup>60</sup> Thus far, only 18 days had elapsed since the date of formal project approval.

The first operation was the removal of the pre-installed surgical equipment, cabinets, and other items from the interior of the truck.<sup>61</sup> Upon completion of this task, the actual conversion of the surgical truck into a pilot model dental operating unit was initiated. Additional window assemblies and a new electrical system were installed. The van body of the truck was modified to conform to the new design. Storage cabinets, table tops, and shelving were prepared for ready installation.<sup>62</sup>

By 29 January 1944, well in advance of completion of the above operations, all of the dental equipment and supplies which had been requisitioned by the Office of The Surgeon General had, with the exception of a very few items, arrived at the Equipment Laboratory. Arrangements were thereupon made to have representatives of The Surgeon General's Office, the Air Surgeon's Office, and the Medical Field Service School meet at Carlisle Barracks to render final decision in regard to the location of the equipment which was to be permanently installed in the truck. It was further anticipated that an officer from the Aero Medical Laboratory, Wright Field, Dayton, Ohio, would arrive shortly to begin a two week tour of temporary duty as liaison adviser to the Equipment Laboratory staff.<sup>63</sup>

It was not long before a decision had been reached, through joint consultation, as to the placement of the permanent equipment as well as the general layout of other interior fittings. Actual installation of dental equipment and packing of dental supplies then went forward under the

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supervision of the Post Dental Surgeon, Carlisle Barracks, and the Director of the Dental Division, Medical Field Service School. A representative of the Aero Medical Laboratory was present throughout this part of the conversion period.<sup>64</sup>

Having set an extremely early target date for the completion of the project, the staff of the Equipment Laboratory devoted a considerable portion of its time to this particular activity during the weeks to follow. Due partly to this fact, and partly to the complete absence of outside interference--last-minute equipment list revisions, changes in interior design, and the like--work on the truck progressed smoothly and rapidly. By 21 February 1944, the mobile unit was finished--just six weeks after formal establishment of the project.<sup>65</sup>

Equipment Laboratory officials were highly satisfied with the new vehicle, so much so in fact that, in a letter to The Surgeon General announcing completion of the truck, it was suggested that a brief field trial of the unit would be all that would be necessary. It was pointed out that interior truck space was sufficient, that only standard equipment had been used, and that whether additional equipment or less equipment was desired, this would make little difference unless special installation was required. This latter remark referred to certain Air Force recommendations which were being forwarded in the same mail. Representatives of the Aero Medical Laboratory, while apparently pleased with the unit, desired to make a more complete use of storage space by adding laboratory equipment. Their proposed supplementary list contained twenty-eight items, in quantities ranging from one to four each, all relating primarily to prosthetic dentistry.<sup>66</sup>

On 27 February 1944, the new unit was driven to Washington for an on-the-spot inspection by members of The Surgeon General's Office.<sup>67</sup> The reaction, as will be seen below, was extremely favorable. Moreover, Air Force recommendations for the inclusion of dental laboratory equipment were overruled. Equipment lists were, it was stated, to remain intact--at least for the time being.

Again I wish to compliment you on the very nice job in producing the pilot model of the Mobile Dental Operating Unit. I looked it over and couldn't find a thing to criticize.

In reference to the extra equipment recommended by Foster and Appleman, [the Air Force representatives] we are of the opinion that it should not be included.

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General Mills [Director of the Dental Division] is of the opinion that the unit should remain as is and that after a dental officer has used it he can add anything he wants to it.<sup>68</sup>

Photographs, specifications, and drawings for the new unit were prepared by the Medical Department Equipment Laboratory and delivered to The Surgeon General's Office on 26 February 1944.<sup>69</sup> All that now remained to be done was to test the performance of the vehicle under field conditions.

#### D. Service Testing of the Dental Operating Truck.

From the start of this project it had been recognized that the need for mobile dental operating units had already become too urgent to permit an elaborate type of field testing which might extend over a period of months. The attitude of The Surgeon General's Office on this point was reflected in a letter written by the Director of the Dental Division to the Director of the Medical Department Equipment Laboratory on 14 January 1944, which contained this statement:

The idea at present is to standardize this unit without a service test. It might be a good idea, when completed, to put a dentist from your post in it and let him operate there for a week.<sup>70</sup>

This was, in fact, the plan that was subsequently followed. Upon return of the pilot model dental operating truck from Washington to Carlisle Barracks in March, a four-day field service test of the unit was immediately initiated by personnel of the Station Hospital Dental Clinic of that post. The comments of this group of officers, which were forwarded to the Equipment Laboratory upon completion of the test, 7 March 1944, are quoted here in full.

We have had the dental operating unit in use here for four days, and it was operated by different dental officers each day with very satisfactory results. They report they were able to care for patients adequately and at a rate equal to their offices in the regular clinic. They suggested only one change, that is, in the operating light which was a little too diffused. This will be taken care of. The following items of equipment are desired:

1. Forceps of some kind to take hot instruments out of the sterilizer, such as, large

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- dressing or sponge forceps.
2. Flashlight.
  3. Wire brush to clean burs, Item 50310.
  4. Suture needles, curved eye No. 1.
  5. Wheel bristle polishing brushes (now in supply table as old, disk, bristle, an issue while in stock).
  6. A ball burnisher, probably Plugger Ladmore double end; Item 54400 would do.
  7. Points, assorted for angle and straight hand pieces, carborundum, mounted; Items 54540 to 54830.
  8. Brush tooth, polishing Item 53020; an issue while in stock.

Otherwise they had no other comments. Colonel Harper talked to me about it and said he was also writing you. One officer suggested sky lights, but their value would not be much in comparison to the cost and engineering required.

We are holding the truck now awaiting further orders.<sup>71</sup>

A summary of the foregoing report, together with a copy of the list of suggested additional equipment, was forwarded immediately by the Equipment Laboratory to The Surgeon General's Office.<sup>72</sup> Four days later, on 11 March 1944, a revised equipment list was prepared by the Dental Division, incorporating most of the recommendations which had been made by the testing officers at Carlisle Barracks. After submission of these changes to the newly organized Technical Division (formerly Research and Development Division) for concurrence, the list was sent on to the Supply Service for final action.<sup>73</sup> The dental operating truck was now ready for standardization.

Exterior and interior photographs of the completed mobile dental operating unit (see Figures 31 and 32) are presented in the pages immediately following.

#### IV. Standardization and Procurement.

##### A. Standardization Phase.

Within a week after construction of the dental operating truck had been completed, members of the Technical Division of The Surgeon General's Office were busily engaged in assembling the data necessary for standardization of the vehicle. By 28 February 1944—before the new unit had even been subjected to field trial—this information, complete

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except for a final determination of quantity requirements, was forwarded for action to the Medical Department Technical Committee.<sup>74</sup>

Computation of total requirements and replacement rate was obtained a few days later. On a proposed basis of issue calling for (a) four mobile dental operating units per Table of Organization and Equipment 8-500 (Dental Operating Team) and (b) two units per Table of Organization and Equipment 8-611 (Medical Depot Company),<sup>75</sup> requirements for 1944 and 1945 were calculated by the Supply Service at 138 and 39 vehicles, respectively.<sup>76</sup> In the Technical Division's original memorandum, an additional bulk allotment of fifty vehicles had been established for Army Air Forces. At the request of The Air Surgeon's Office, this figure was now increased to fifty vehicles for 1944 plus twenty-five for 1945. It was also suggested by The Air Surgeon that distribution of the subject item to Air Force units in the various Theaters of Operation be made "in accordance with their tactical needs", this allocation to be accomplished at the discretion of the Surgeon of each Air Force, with the coordination of the Air Surgeon.<sup>77</sup>

With preliminary data now complete, on 3 March 1944 the Subcommittee of the Medical Department Technical Committee met and approved standardization of the new item under the nomenclature, "Truck, 2½-Ton, 6X6, Dental, Operating." It was further recommended that the Ordnance Department be responsible for specifications, purchase, maintenance, and inspection of the truck chassis and body, electric wiring, lights, hot water heater, sink, and plumbing. Responsibility for all other supply and maintenance functions affecting the unit should, it was proposed, be assigned to the Medical Department.<sup>78</sup>

On 6 March 1944, the above report was approved by the Medical Department Technical Committee with but one modification. It was decided that, instead of a single listing for both truck and equipment as suggested by the Subcommittee, the Medical Department equipment for the dental truck should be standardized under a separate item number before incorporation into the prescribed Tables of Organization and Equipment.<sup>79</sup> This change was more significant than might be supposed.

In the case of the mobile dental laboratory, where a single rather than a double listing method had been adopted, considerable inconvenience and confusion was subsequently experienced. Not only did requisitioning procedures immediately become much more complicated, but it was soon discovered that in depots where dental laboratory equipment was assembled separately from the truck, there was no proper

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means of accounting for it for storage and shipment purposes.<sup>80</sup>

Such difficulties had now been avoided by the above action of the Medical Department Technical Committee.

As we have seen in the preceding section, on 11 March 1944 a final revised equipment list, incorporating changes suggested by testing personnel at Carlisle Barracks, was prepared by the Dental Division and submitted to the Supply Service of The Surgeon General's Office.<sup>81</sup> On the following day, all of the foregoing standardization data was forwarded for approval to the Commanding General, Army Service Forces.<sup>82</sup> Authority for the designation of the mobile dental operating unit as a standard article was granted by that office on 16 March 1944.<sup>83</sup>

#### B. Procurement Phase.

While it had taken only two and a half months to develop, test, and standardize the dental operating truck, three additional months were now consumed in getting the item into procurement. The problems encountered at this state were for the most part minor or technical in nature and their solution was not difficult, but in the aggregate they represented a rather substantial loss of time. In several instances, moreover, it would seem that present difficulties could have been avoided by more careful administration during earlier phases of the project.

For example, a week's delay was now necessitated because of an error which had previously been made in cost computations. While an operating chair, dental operating unit, and operating lamp appeared in the latest Equipment List for the subject unit, somehow the cost of these items had not been included in the total Equipment List cost, but instead had been included in the estimated cost of the dental truck.<sup>84</sup> This discrepancy was duly called to the attention of the Technical Division by the Catalog Branch of the Supply Service,<sup>85</sup> the error was admitted, and by 28 March 1944, a new breakdown of cost data had been forwarded to Supply Service for the indicated recomputation.<sup>86</sup>

It was soon appeared that not only had price statistics been calculated somewhat too hastily during the preceding Standardization Phase, but that basis of issue had also been described with some inexactness. The designation "Four (4) per E/O and E 8-500 (Dental Operating Team)" as one of the distribution criteria for the mobile dental operating unit was, the Technical Division discovered upon reflection, badly in need of amendment. In the first place, Table of Organization and Equipment 8-500 was the table for

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the Medical Department Service Organization rather than for the Dental Operating Team alone as implied above, this latter team being merely one of many components of the parent unit. In the second place, only one dental operating team--not four--was authorized for each service organization.<sup>87</sup>

In order to clarify this particular requirements criterion, therefore, it was requested by The Surgeon General's Office, on 28 March 1944, that the above basis of distribution for Truck, 2½-Ton, Dental, Operating, be changed to read as follows: "One (1) per Dental Operating Team, T/O&E 8-500."<sup>88</sup> Inasmuch as it was felt that this would probably have been the interpretation of supply officials even in the absence of a clarifying amendment, it was not believed that the proposed change in wording would produce any change in total requirements for the vehicle.<sup>89</sup> On 31 March 1944, approval for this action was granted by Headquarters, Army Service Forces.<sup>90</sup>

During the months of April and May, 1944, aside from a few technical changes in specifications and equipment, little was accomplished on the subject project. On 13 April 1944, The Surgeon General's Office notified the Equipment Laboratory that the pilot model dental operating truck was to be sent to Army Medical Center, Washington, D. C., on 15 April 1944 for formal presentation to the Medical Department by the Maryland State Dental Laboratory Guild and the District of Columbia Dental Laboratory Association. It was further requested that the unit be sent on 11 May 1944 to Buffalo, New York, for a similar presentation by the Dental Society of the State of New York.<sup>91</sup>

On 26 April 1944, recommendations for certain minor and largely formal changes in specifications were forwarded to The Surgeon General's Office by the Army Medical Purchasing Office in New York City.<sup>92</sup> Upon completion, a week later, of a new set of specifications incorporating these suggested changes,<sup>93</sup> nothing further appears to have been done by the Technical Division until 24 May 1944. On this date a last-minute substitution was suggested to the Supply Service. It was requested that the Ritter Dental Unit be furnished for the dental operating truck instead of the Water Dental Unit previously specified. It appeared that the latter item, which had been installed in the pilot model, had already begun to show signs of considerable wear, and also that all dental surgeons conferred with had recommended that such a change be made.<sup>94</sup>

On 17 June 1944, after the above rather considerable delays, a purchase order for 35 dental operating trucks, at a unit cost of \$9,000 (including equipment), was placed by the Army Medical Purchasing Office.<sup>95</sup> One further last

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minute change in specifications was necessitated shortly thereafter when it was discovered by the Equipment Laboratory at Carlisle that the type of paint which had been prescribed for the interior equipment was "lusterless" instead of "semi-gloss", the type specified for all other mobile Medical Department Units.<sup>96</sup> Upon completion of this change, no further difficulties incident to the procurement phase of the project were encountered.

### C. Distribution Phase.

On 22 September 1944, the following announcement--the first of its kind noted thus far in this series of studies--was sent by The Adjutant General to commanders of all theaters, defense commands, departments, and bases overseas:

1. In order to provide dental treatment for personnel of units which either have no dental officer assigned or which are not located near hospital installations, there has been developed and standardized Medical Department item #99588-05, truck, 2½-Ton, 6X6, dental operating, and Medical Department item #99588-10, truck 2½-ton, 6X6 dental operating, equipment for.

2. It is anticipated that 32 of these trucks with dental equipment will be available for issue to overseas theaters by 1 October 1944 with additional ones becoming available monthly.

3. The personnel required for the operation of the above equipment is as follows:

1st Lt. or Capt., Dental Corps	1
Dental technician, SSN-855	<u>1</u>
Aggregate	2

4. All overseas theaters having requirements for Medical Department items #99588-05 and #99588-10 should submit requisitions in normal manner, for consideration. If no requirement exists it is requested that The Surgeon General be so advised.<sup>97</sup>

The above communication was an excellent example of informative and well-timed advance publicity. Assuming that this letter was subsequently given appropriate distribution within each of the commands concerned, few overseas units should have been unaware of the existence of the newly developed dental operating truck and of its imminent availability for overseas use. Moreover, as a result of the

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direct solicitation of orders for the new vehicle which was included in the above announcement, supply officials in The Surgeon General's Office were now in a good position to obtain an extremely accurate picture of total overseas requirements.

Unfortunately the expectation that 32 new dental operating trucks would be available for overseas shipment by 1 October 1944 proved to be somewhat over-optimistic. October deliveries on the original factory order of 35 vehicles, placed in June, 1944, totalled only two. Fifteen more trucks were delivered in November, and it was not until the following month that the last of the 35 units had reached our medical depots.<sup>98</sup> In terms of combat utility, therefore, the mobile dental operating unit cannot be said to have seen any very extensive service before the first quarter of 1945.

The flow of new dental operating trucks was continued well into 1945. Additional production contracts were placed and periodic deliveries made throughout the first three quarters of that year. As of 31 October 1945, a total of 138 mobile dental operating units had been contracted for, all of which had been built and delivered. Compared with a total production, as of this same date, of 37 optical repair trucks, 77 medical laboratory trucks, and 107 dental laboratory trucks, it will be seen that the importance of the dental operation truck, from the standpoint of quantity requirements, was considerable. Only the surgical operating trucks were, at this point, in greater demand.<sup>99</sup>

An idea of the overseas distribution of the dental operating truck, as projected in October, 1944, can be gained from the following table:

Truck, 2½-Ton, 6X6, Dental Operating

<u>Theater of Operation</u>	<u>Authorized by 31 Dec. 1944</u>	<u>Authorized by 31 Dec. 1945</u>
Pacific Ocean Area	5	5
North African Theater	18	20
China-Burma-India	18	18
So. Pacific Base Command	4	4
European Theater	33	33
Southwest Pacific Area	15	15

V. The Dental Operating Truck (Army Air Forces).

Although aware that the Medical Department had already launched a full-scale development project to produce a mobile dental operating unit--in fact, having given its formal concurrence to the establishment of that project--Army Air Forces nevertheless went ahead with its own experimentation in this field. On 11 February 1944--just ten days before completion of the pilot model dental operating truck (Medical Department) at Carlisle Barracks, Pennsylvania--the Engineering Division of Army Air Forces Materiel Command issued a lengthy report describing all the various mobile dental operating units which had been brought to the attention of the Aero Medical Laboratory at Wright Field, Dayton, Ohio.<sup>2</sup> The report was evidently intended as a preliminary survey of the research field, indicating the alternatives that were being considered. As was expected, this was followed somewhat later by a second technical report describing the unit which had subsequently been developed by the Aero Medical Laboratory.<sup>3</sup>

The Air Forces' February report included a description and discussion of a number of different experimental dental operating units.<sup>4</sup> Trailer conversions, for example, had been tried out at several Army Air Bases. At the Rapid City Army Air Base, Rapid City, South Dakota, an Army Air Forces office trailer had been fitted out as a dental office and had been used successfully in the field. At the Army Air Base at Great Falls, Montana, a dental trailer had been made up and used to supply dental service to three satellite fields. Inasmuch as a tour of those fields involved 900 miles of travelling, the trailer innovation had amounted to a considerable saving both in patient-time and expense to the Government. Finally, the Third Fighter Command at Drew Field, Florida, had a two-wheel office trailer, which had been equipped as a mobile dental unit and had greatly aided the dental service of the Command.

In commenting upon the above, the Aero Medical Laboratory pointed out that, while trailers appeared to work fairly satisfactorily in this country, information received from overseas units indicated a less favorable reaction. There, trailer units had been found to bog down with too much weight in certain terrain, and, due to their complete dependence upon tow trucks, often became immobilized at the time of a general movement because of lack of a prime mover. For these reasons, it was recommended that trailers be considered only for use within the continental United States, if at all.

The major alternative remaining for overseas units was, therefore, some type of self-contained vehicle, capable of



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supplying its own motive power. Several models were listed in this category, but it was clear where the preference lay. Passing reference was made to a single-vehicle unit used by the New York State Department of Health and to a drawing of a similar dental unit designed for use in Puerto Rico, submitted by the Ransom and Randolph Company of Dayton, Ohio. But chief emphasis was given to the small arms ordnance repair truck which, as we have already noted, had been converted into a mobile dental operating unit by the Twelfth Air Force in North Africa. It was stated that with this mobile equipment dental officers had been able to complete fifty percent more work than with their conventional non-mobile field equipment.

Developing this latter idea, the Aero Medical Laboratory went on to describe in some detail the truck, 2½-ton, 6x6, Ordnance, Maintenance, the basic vehicle upon which the small arms repair truck had been patterned. It was explained that the subject vehicle came equipped with blackout curtains, complete electric wiring, gasoline burning heating unit, six windows on each side, and that it drove on all six wheels. Interior dimensions were shown to be ample for the purpose intended. In short, it was clear from the report that future experimentation in this field by the Aero Medical Laboratory would be largely concerned with the latter vehicle.

Although the formal report of the subsequent development by the Aero Medical Laboratory of a new mobile dental operating unit, using the chassis and body of the Ordnance maintenance truck, was not published until 7 October 1944,<sup>5</sup> actual construction work had been completed several months before. In fact, on 9 July 1944, representatives of The Surgeon General's Office and the Medical Department Equipment Laboratory, together with certain dental officer representatives of the Washington vicinity, visited Wright Field for the express purpose of inspecting the new Air Force unit.<sup>6</sup> By this date, it may be observed parenthetically, the Medical Department's model had already been developed, tested, standardized, and placed under procurement.<sup>7</sup>

On the day following this visit to Wright Field, a brief written report of the inspection trip was prepared by a member of the Technical Division of The Surgeon General's Office. It was pointed out first of all that the basic vehicle used in the construction of the Air Force dental operating unit was the 2½-ton, 6x6, Ordnance Maintenance Truck, the body of which was six inches wider and one foot shorter than the standard Medical Department truck.

While the above statement was not elaborated, its import was evident. The Medical Department Vehicle Program, in which the dental operating truck represented merely one of a series

of related units, was based entirely upon the 2½-ton, 6x6, Ordnance Cargo Truck. Manifestly, any deviations from the structural dimensions or design of this basic vehicle would only complicate further already difficult problems of production and maintenance.

As for the other characteristics of the Air Forces model, the inspecting officer concluded his report with the following general comment:

. . . . The item presents no particular advantage over the one developed by the Medical Department Equipment Laboratory in conjunction with the Dental Division of this office.

As we shall see shortly, this latter statement was not to pass unchallenged. In the early part of January, 1945, a stout defense of the Air Force model was presented by the President of the Army Air Forces Board at Orlando, Florida.<sup>10</sup>

In any event, to return now to our narrative, on 7 October 1944, the Aero Medical Laboratory issued its final memorandum report on its dental operating truck project. The report consisted of a carefully written, 27-page document supplemented by 20 photographs. The recommendations arrived at, however, were somewhat general. No attempt was made to force a comparison between the Air Force model and the now standard Medical Department unit. The plea was simply for continued procurement of dental operating vehicles, whatever their type.

It is urgently recommended that mobile dental operating units be procured for Army Air Forces organizations, both overseas and within continental United States. Even if hostilities should cease in the near future, a large army of occupation will need dental attention, and any surplus equipment of this type will serve a good purpose after the war.<sup>11</sup>

The Air Force model was not, however, destined to pass out of the picture unnoticed. A large illustration of the unit appeared on the cover of the December, 1944, issue of The Air Surgeon's Bulletin, and a full-column article described the vehicle in considerable detail.<sup>12</sup> A month later, on 12 January 1945, the issue of the Air Force model versus the Medical Department dental operating truck was at last explicitly stated. In a letter to the Commanding General, Army Air Forces, the President of the Army Air Forces Board, Orlando, Florida, asserted that the experimental dental operating unit developed by the Aero Medical Laboratory possessed a number of advantageous features which were not



offered in the Medical Department model. After discussing each of these features in some detail, the author of the communication concluded with the recommendation that they be considered for inclusion in future mobile dental units issued to field organizations.

Because of its potential interest to future students of this particular vehicle, this communication is quoted here in full.

1. The Aero Medical Laboratory of the Air Technical Service Command has developed a mobile dental unit which is described in detail in Inclosure 1. A similar mobile dental operating unit has been developed by the Army Service Forces. It is believed that the unit developed by the Air Technical Service Command possesses the following advantages:

a. BODY.

The body of the Aero Medical Laboratory model has six (6) windows on each side as compared to two (2) on each side of the standard model. The importance of this advantage can not be over-stressed. Maximum light and ventilation is apparent to both the dentist and the patient. The floor space of each body type is very nearly equal. The standard model is 13 feet X 7 feet (91 sq. ft.). The Aero Medical model is 12 feet X  $7\frac{1}{2}$  feet (90 sq. ft.). The rear door of the Aero Medical model is ten (10) inches larger in each direction (52 in. X 70 in.). The standard model measures 42 inches X 60 inches. The 70 inch height of the door in the Aero Medical model gives much greater ease of entrance and exit; a very distinct advantage. A very efficient gasoline burning heater for cold weather operation, is mounted on the inside front wall of the body. This item comes as standard equipment with this truck.

b. MOUNTING OF DENTAL UNIT

In the Air Technical Service Command dental truck, the dental unit is mounted on a level the same as the floor of the truck. This places the dental cuspidor at a proper level for use by the patient and places the entire unit in such a way that it can be used efficiently and comfortably by the dentist.

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c. WATER SUPPLY SYSTEM

An eighty (80) gallon water tank is bolted to the floor under the work bench in the Aero Medical model. The standard model has a fifty (50) gallon water tank mounted high on the front wall of the body. The tank in the Aero Medical model may be loaded through an outside garden hose connection, or local water pressure may be used if available. The tank may also be loaded by bucket, from a well or spring by use of a funnel through the work bench top. The tank in the standard model must be loaded either by hose or bucket through a pipe in the top of the body. Moreover, the placing of the water tank high on the front wall of the body of the truck tends to make the truck top heavy and to give it undesirable driving characteristics, if the truck is moved when the water tank is filled. It is believed to be a distinct advantage to enable the dentist to travel with a full water tank, since arriving at other stations the dentist may find the water supply very limited or not suitable for his use. The hot water tank in the Aero Medical model holds eight (8) gallons. The standard model has a five (5) gallon hot water tank.

d. EMERGENCY FEATURES

In the Aero Medical model definite consideration has been given to the possibility of electric power failure, due either to lack of local current supply or breakdown of the generator. In case of power failure, air pressure may be supplied through an emergency air intake (tire valve) on top of the water tank, by the use of an ordinary hand pump. A foot engine is provided, as well as an alcohol burning sterilizer and two alcohol lamps. A relief valve (set at 70 pounds) is installed in a pipe leading from the top of the water tank and extending through the floor of the truck. If the pressure ever reached 70 pounds (through failure of the compressor cut-off switch, or too much heat under the hot water coils) it will be relieved through the floor without damage to personnel or equipment.



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e. STORAGE SPACE

The Aero Medical model has more storage for both expendable and non-expendable supplies than the standard model. By the use of an overhead cabinet on each side, it is estimated that expendable material, sufficient for three (3) months operation may be carried.

f. LAUNDRY EQUIPMENT

In the Aero Medical model, a tank of acetylene supplies gas through a 3-way valve on the work bench for blow-pipe and bunsen burner. This may be used in the repair of removable dental appliances, as well as fixed bridgework. Also sufficient laboratory equipment is provided for the repair of broken partial and full dentures. It is not known to what, if any extent, laboratory equipment is provided in the standard unit.

2. It is recommended that the advantageous features of the Mobile Dental Unit developed by the Aero Medical Laboratory of the Air Technical Service Command be considered for inclusion in mobile dental units which will be issued to field organizations.<sup>13</sup>

The above document has an historical importance only, for it does not appear that the recommendations which it contained ever received practical implementation. The communication was forwarded routinely by the Chief of the Supply Division, Air Surgeon's Office, through the Dental Division of The Surgeon General's Office with the notation: "This report is forwarded to your Laboratory for information."<sup>14</sup> On 6 February 1945, the report was accordingly sent to the Laboratory at Carlisle Barracks with the one-word indorsement: "Forwarded".<sup>15</sup> The records do not disclose that any further action was taken in the matter.

Photographs of the non-standard Air Force model (see Figures 33 and 34) are presented for purposes of comparison on the pages immediately following.

VII. Conclusion.

A. Post-Standardization Changes.

Although the Medical Department dental operating truck had been standardized after only a four-day field trial,

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only one complaint of consequence appears to have been subsequently registered against the unit. In February, 1945, the Regional Hospital at Fort Jay, New York, reported that in temperatures ranging from zero to  $-31^{\circ}$  Fahrenheit the water pipes of the unit froze and split and the heater coil cracked. Attempts to remedy this condition by installing larger piping, reducing the number of elbows and bends, and inserting additional drains, had been unsuccessful. Representatives of the Krieger Steel Company, manufacturers of the truck, had been consulted and were of the opinion that a chemical reaction had occurred--as a result of extreme low temperatures acting upon certain minerals in the water--and that this, in turn, had produced a pipe corrosion which might have impeded the water flow.<sup>16</sup>

In accordance with verbal instruction from The Surgeon General's Office, the problem described above was promptly investigated by officials of the Medical Department Equipment Laboratory. The theory that the damage was either traceable to some structural defect in the vehicle's plumbing system or that it was caused by some special type of pipe corrosion, was rejected at the outset. The fact that the pilot model dental operating truck had been out in the open all winter at Carlisle Barracks in temperatures down to  $10^{\circ}$  below zero without suffering any damage to the water system was felt to be a sufficient refutation of both these hypotheses.

Actually, it was believed, improper preventive maintenance had been the real cause of the reported difficulties. The dental truck, it was pointed out, was provided with an air compressor designed to furnish positive air pressure at all times. If, while this compressor was running, all valves and faucets were kept open, complete drainage would be obtained unless there was a definite stoppage in one of the pipes. The rupture of pipes and fittings in the above instance was, therefore, in all probability due either to failure to drain the water properly before storing the vehicle where it would be subjected to sub-zero temperatures, or it was due to a failure to notice and prevent an accumulation of sediment in the water line which might clog the system.<sup>17</sup>

Apparently the Equipment Laboratory's analysis was a sound one for no further complaints of this nature were received. The case did, however, serve to illustrate a need which had not received adequate attention in the past--the need for detailed operating instructions for each new item of equipment.

It is suggested that a complete set of operating instructions for each piece of



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Equipment made at the time equipment is developed, and completed, would forestall such failures outlined in basic communication. At the time of development of this item, no one was charged with the drafting of operating instructions. Medical Department Equipment Laboratory has not prepared any instructions until the last few projects.<sup>18</sup>

The above recommendation was well-timed. A basic Medical Department van truck, to be used for all future mobile medical unit conversions, had just been designed but no operating instructions had been included along with the specifications. This omission, now brought forcibly to the attention of The Surgeon General's Office, was soon to be remedied. Furthermore, as we shall see from the statement of the Technical Division quoted below, the remedy was to be extended to all other related Medical Department vehicles as well.

... Since such operating instructions have not been furnished with the basic vehicle steps will be taken immediately to have operating instructions prepared for this vehicle and the other five mobile units which use the same basic truck. These will be forwarded to the Office Chief of Ordnance with appropriate recommendations.<sup>19</sup>

The Equipment Laboratory's suggestion had had a far-reaching effect.<sup>21</sup>

The experience of the Fort Jay Regional Hospital, previously discussed, stressed the importance of proper drainage in preventing the freezing of the water pipes installed in the dental truck. Several months later, a suggestion was received from a station hospital at Fort Sheridan, Illinois, which was to make possible continued operation of the dental unit even while the hot water heating coil and other exterior piping were being drained. The alteration proposed would also make possible the saving of the five gallons of water in the hot water storage tank during this operation.

Specifically, it was recommended that cut off valves be installed inside the van body, one on the pipe that led to the heater, and the other immediately below the hot water storage tank. By closing both these valves and opening both the hot water faucet and the drain pet cock on the heater coil, the coil could be entirely drained without cutting off the water at the sink or at the dental operating unit itself.<sup>20</sup>

This proposal met with the immediate approval of the Equipment Laboratory and, inasmuch as that office was then in contact with the Chief of Ordnance, Detroit, preparatory to the standardization of the basic Medical Department van truck, basic drawings were accordingly revised to include the structural improvement mentioned above.<sup>21</sup>

B. Physical Evaluation.

Proceeding now to a general evaluation of the standard dental operating truck, it would appear that user-reaction as a whole has been highly favorable. Officials in the Dental Division of The Surgeon General's Office praise the unit,<sup>22</sup> and demand has been relatively widespread, with even the United States Coast Guard making a special requisition for the vehicle.<sup>23</sup> A spot check of overseas reactions further tends to confirm this positive judgment.<sup>24</sup>

It could scarcely be denied that the dental operating truck was a notable improvement over the awkward cargo truck-dental chest system that had previously been used in itinerant dental service. The inclosed dental truck made possible the carrying out of dental operations even in the most inclement weather, required no extensive and time-consuming packing and unpacking operations when the unit moved from one location to another, and, being duly authorized equipment under official Tables of Organization, was available for the dental operating team to which it had been assigned. In view of all these advantages, there is little wonder the dental staff of the Twelfth Air Force declared that even their improvised mobile dental unit had made it possible for dental surgeons to perform fifty percent more work than formerly.<sup>25</sup>

As for a comparison of the standard mobile dental operating unit developed by the Medical Department and the nonstandard model produced by Army Air Forces, one factor overshadows all others in importance. The truck chassis and special van body used for the Medical Department model were the same as those used in the manufacture of the entire series of mobile medical unit--the surgical truck (Armored Force), the Medical laboratory truck, the dental laboratory truck, the optical repair truck, and the surgical operating truck. The ultimate development and standardization of one basic Medical Department van truck for use with all mobile medical units was, therefore, a comparatively simple matter. The Air Force model, however, was built around a different Ordnance truck and a different body. Adoption of this latter vehicle by the Medical Department would inevitably have raised formidable production problems and,



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because of a lack of high interchangeability of parts, almost equally formidable maintenance and supply problems.

As for a more detailed comparison of interior design, choice of equipment, and structural characteristics-- this is left to the judgment of the individual reader. Army Air Forces contended that its model possessed several features which could have been incorporated with profit in Medical Department specifications. By its inaction, the Medical Department would seem to have indicated its disagreement with this viewpoint.

### C. Administrative Aspects.

Once Development Project, F-39 had been instituted, its administration was excellent--up to the final procurement stage. As a result of a positive policy of centralized direction, a clear distribution of research and development functions had been made at the outset. Each participating office had a specific job to do and, consequently, a direct and personal responsibility to see that that job was done quickly and well. The results speak for themselves.

The preparation of equipment lists, which in previous projects had sometimes taken as long as eighteen months, was accomplished in a matter of days. Procurement of supplies and equipment for the pilot model, which under earlier decentralized procedures had on occasion delayed project completion by as much as nine months, was here completed under central handling by The Surgeon General's Office in less than two weeks. The Equipment Laboratory, working directly with on-the-spot liaison officers instead of having to rely on long range correspondence for the coordination of its activities, had in a few short weeks constructed a complete experimental model ready for immediate service test. As for standardization, all the procedural steps required by AR 850-25 were complied with to the letter and yet the total time consumed by these processing actions was under three weeks.

Although the causes of the change are not evident from the data, a decided drop in administrative speed and efficiency occurred upon completion of the standardization phase of this project. Pre-procurement activities, involving merely a few last-minute changes of a minor or technical nature, dragged out over a period of three months. Another six months elapsed before all deliveries had been made on the first production order placed in June, 1944, so that it was not until the first quarter of 1945 that overseas shipment of the new vehicle reached significant proportions.

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That these various post-standardization tasks should have taken over nine months to complete was unfortunate in view of the excellent progress that had been made in the preceding stages of the project.

Duplication of research effort on the part of the Medical Department Equipment Laboratory and the Aero Medical Laboratory of the Air Service Command has already been commented upon at some length. Suffice it to say that, apart from the Medical Department's successful action in preventing quantity procurement of the Air Force Model, there appears to have been a general reluctance on the part of all concerned--The Surgeon General's Office, the Air Service Command, Headquarters, Army Service Forces, and Headquarters, Army Air Forces--to make a definite issue of this matter of parallel experimentation so that one or the other of the two identical projects would be eliminated.

Before concluding this section, some mention should be made of two new administrative procedures which were employed during the course of the present project. First, the problem of giving newly standardized medical equipment items adequate advance publicity was solved here by the issuance to all overseas installations of a letter from The Adjutant General's Office giving full details regarding the new dental operating truck, including the estimated date of its availability. Second, events which occurred in this project served to dramatize the need for the regular preparation of a complete set of operating instructions, to be issued with each newly developed item of equipment. The subsequent formal establishment of this policy with respect to all related Medical Department vehicles was the direct result of the recommendations made by the Equipment Laboratory in March 1945.

#### D. The Time Element.

The Medical Department dental operating truck was, as we have seen, a highly satisfactory vehicle. Moreover, despite delays in procurement and distribution, this unit had been developed, service tested, standardized, and put into the field in only slightly more than a twelve-month period. Compared with previous projects, where two or more years had been required for a similar type of undertaking, the record achieved in the present instance was remarkably good.

The fact, therefore, that the new mobile dental operating unit did not reach overseas theaters in quantity until the first quarter of 1945, and consequently saw only a limited amount of actual combat service, must be viewed in



this perspective. Only to a very limited extent was the delay chargeable to the administration of Development Project, F-39. Had production, procurement, and overseas distribution been completed in record time, the unit would still have seen far less than a year's battle service.

The basic cause of the failure to get a new dental operating vehicle to troops overseas in time to be of maximum use was simply the lateness of the decision to establish a full-scale development project to produce such an item. Once this decision had been made, the performance of research and development personnel was at as high a level of efficiency as at any time during the course of the war.

FOOTNOTES TO CHAPTER IX

- <sup>1</sup>The Medical Department of the United States Army in the World War, Vol. II, 1928, p. 119. The material for this section has been drawn exclusively from the above account.
- <sup>2</sup>Annual Report of The Surgeon General, U. S. Army, Vol. II, 1919, p. 1303.
- <sup>3</sup>Ibid.
- <sup>4</sup>Ibid., p. 1302.
- <sup>5</sup>Annual Report of The Surgeon General, U. S. Army, 1919-1940, incl.
- <sup>6</sup>The Army Medical Bulletin, No. 39, Apr., 1937, pp. 74-75.
- <sup>7</sup>Memo. to Research & Development Div., S.G.O., fr. Dental Div., S.G.O., 29 May 1942 (A.M.R. & D. Bd.).
- <sup>8</sup>Ibid.
- <sup>9</sup>Ibid.
- <sup>10</sup>Memo. to Medical Dept. Subcommittee, fr. Chf., Research & Development Div., S.G.O., 20 May 1942 (A.M.R. & D. Bd.).
- <sup>11</sup>Memo. to Hist. Div., S.G.O., fr. Dental Div., S.G.O., 27 Jan. 1944. See Incl. 1, "Dental Division History, 1 - 22 Jan. 1944," pp. 2-3 (Hist. Div., S.G.O.).
- <sup>12</sup>Min. of M.D.T.C., 1942-1943, incl. (Hist. Div., S.G.O.).
- <sup>13</sup>Pencilled notation, initialled by Leon H. Warren, Chf., Research Coordination Br., Research & Development Div., undated; (A.M.R. & D. Bd.).
- <sup>14</sup>Ltr. to C.G., A.A.F. (Attention: Air Surgeon), fr. 12th Air Force, APO 650, 12 Sep. 1943; subject: "Mobile Dental Equipment" (Rec. Rm., S.G.O. 451.2-1).
- <sup>15</sup>Memo. to Hist. Div., S.G.O., fr. Dental Div., S.G.O., 1 Feb. 1945. See Incl. 1, "Dental Division History, 15 Jan. 1945 - 31 Jan. 1945," p. 3. (Hist. Div., S.G.O.).  
Memo. to Hist. Div., S.G.O., fr. Dental Div., S.G.O., 16 Dec. 1944. See Incl. 1, "Dental Division History, 1 Dec. 1944 - 15 Dec. 1944," p. 6 (Hist. Div., S.G.O.).



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- 16 Memo. to Hist. Div., S.G.O., fr. Dental Div., S.G.O., 27 Jan. 1944. See Incl. 1, "Dental Division History, 15 Nov. 1944," p. 6 (Hist. Div., S.G.O.).
- 17 Ibid., p. 2.
- 18 Ltr. to The Air Surgeon, Hq., A.A.F., fr. Hq., 12th Air Force, APO 650, 21 May 1943; subject: "Mobile Dental Operating Units." This document is cited in ltr. to The Air Surgeon, Hq., A.A.F., fr. Hq., 12th Air Force, APO 650, 10 Sep. 1943; subject: "Mobile Dental Unit Mounted on Small Arms Ordnance Repair Truck" (Rec. Rm., S.G.O., 451.2-1).
- 19 Ltr. to C.G., A.A.F. (Attention: Air Surgeon), fr. 12th Air Force, APO 650, 12 Sep. 1943; subject: "Mobile Dental Equipment" (Rec. Rm., S.G.O., 451.2-1).
- 20 Memo. to Dental Div., S.G.O., fr. Hq., A.A.F., 30 Jul. 1943 (Dental Div., S.G.O.).
- 21 Ibid.
- 22 Ibid.
- 23 Ltr. to The Air Surgeon, Hq., A.A.F., fr. Hq., 12th Air Force, APO 650, 10 Sep. 1943; subject: "Mobile Dental Unit Mounted on Small Arms Ordnance Repair Truck" (Rec. Rm., S.G.O., 451.2-1).
- 24 See n. 19, above.
- 25 Ltr. to S.G.O., fr. Chf., Supply Div., Air Surgeon's Office, Hq., A.A.F., 11 Oct. 1943; subject: "2 1/2-ton, 6x6, Laboratory, Dental" (Rec. Rm., S.G.O., 451.2-1).
- 26 1st Ind. to C.G., A.A.F., AFTAS, fr. Operations Service, S.G.O., 19 Oct. 1943; basic: see n. 25, above (Rec. Rm., S.G.O., 451.2-1).
- 27 Ltr. to Asst. Surgeon, Medical Sec., Hq., 12th Air Force, APO 650, fr. Office of The Air Surgeon, Hq., 12th Air Force, APO 650, 1 Nov. 1943; subject: "Development of Mobile Dental Unit." This document appears as Part C, Appendix I, to Aero Medical Laboratory Report, 11 Feb. 1944; subject: "Mobile Dental Operating Units; Serial Number ENG-49-698-26" (A.M.R. & D. Bd.).
- 28 Ltr. to C.G., Air Service Command, fr. Chf., Ordnance Aircraft Service, A.A.F. Materiel Command, 1 Dec. 1943; subject: "Procurement of Trucks, Machine Shop Experimental"; record summary (A.M.R. & D. Bd.).

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29 1st Ind. to C.G., A.S.F., fr. C.G., A.A.F., Air Service Command, 2 Dec. 1943; basic: see n. 28, p. 524; record summary (A.M.R. & D. Bd.).

30 2d Ind. to Chf., Ordnance Dept., fr. Hq., A.S.F., 14 Dec. 1943; basic: see n. 28, p. 524 (A.M.R. & D. Bd.).

31 Interview with Col. Rex McK. McDowell, D.C., Dental Div., S.G.O., 19 Feb. 1946.

32 Memo. to Research Coordination Br., Plans Div., S.G.O., fr. Dir., Dental Div., S.G.O., 16 Dec. 1943 (A.M.R. & D. Bd.).

33 AR 850-25, 30 Jun. 1943, Sec. I, Par. 4.

34 Memo. to Dir., Technical Div., S.G.O., fr. Development Br., Technical Div., S.G.O., 10 Jul. 1944; subject:

"Visit to Wright Field, Dayton, Ohio, on 9 July 1944" (A.M.R. & D. Bd.). Also see Memorandum Report No.

ENG-49-698-26, Engineering Div., A.A.F. Materiel Command, 11 Feb. 1944, p. 46, Photograph No. 1630 (A.M.R. & D. Bd.).

35 Interview with Col. Rex. McK. McDowell, D.C., Dental Division, S.G.O., 19 Feb. 1946.

36 See n. 32, above.

37 Ltr. to M.D.T.C., fr. Medical Dept. Technical Subcommittee, 21 Dec. 1943; subject: "Medical Department Technical Subcommittee Report on: Mobile Dental Operating Outfit" (A.M.R. & D. Bd.).

38 Ltr. to C.G., A.S.F., fr. S.G.O., 30 Dec. 1943; subject: "Mobile Dental Operating Unit." See Incl. 2 (A.M.R. & D. Bd.).

39 Ltr. to C.G., A.S.F., fr. S.G.O., 30 Dec. 1943; subject: "Mobile Dental Operating Unit," 3 Incls. (A.M.R. & D. Bd.).

40 2d Ind. to Chf., Ordnance Dept., fr. Hq., A.S.F., 14 Dec. 1943; basic: see n. 28, p. 524 (A.M.R. & D. Bd.).

41 1st Ind. to S.G.O., fr. Hq., A.S.F., 6 Jan. 1944; basic: see n. 39, above (A.M.R. & D. Bd.).

42 Ltr. to S.G.O. (Thru: C.G., A.S.F.), fr. Chf., Supply Div., Air Surgeon's Office, Hq., A.A.F., 30 Dec. 1943; CONFIDENTIAL; subject: "Requirements of Equipment to be Installed on Mobile Dental Units" (Rec. Rm., S.G.O., X-451.8-1). Extracted in clear.



- 43 1st Ind. to S.G.O., fr. Development Br., Requirements Div., A.S.F., 6 Jan. 1944, CONFIDENTIAL; basic: see n. 42, p. 525 (Rec. Rm., S.G.O., X-451.8-1). Extracted in clear.
- 44 2d Ind. to C.G., A.A.F. (Thru: C.G., A.S.F.), fr. S.G.O., 11 Jan. 1944, CONFIDENTIAL; basic: see n. 42, p. 525 (Rec. Rm., S.G.O., X-451.9-1). Extracted in clear.
- 45 Ibid. Note channels indicated.
- 46 Ibid.
- 47 Ltr. to S.G.O., fr. Chf., Supply Div., Air Surgeon's Office, Hq., A.A.F., 22 Jan. 1944; subject: "Mobile Dental Units, Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania" (A.M.R. & D. Bd.).
- 48 1st Ind. to M.D.E.L., fr. S.G.O., 25 Jan. 1944; basic: see n. 47, above (A.M.R. & D. Bd.).
- 49 Ltr. to Hist. Div., S.G.O., fr. M.D.E.L., 4 Dec. 1945; subject: "Truck, 2 $\frac{1}{2}$ , Optical Repair Unit, Project F-32 and Truck, 2 $\frac{1}{2}$ , 6x6, Dental Operating, Project F-37, Histories of." See Incl. 2, p. 7 (Hist. Div., S.G.O.).
- 50 Ltr. to S.G.O., fr. Arms & Requirements Br.; Canadian Army Staff, Washington, D.C., 4 Jan. 1944 (A.M.R. & D. Bd.).
- 51 Memo. to Hist. Div., S.G.O., fr. Dental Div., S.G.O.: 27 Jan. 1944. See Incl. 1, "Dental Division History, 1 Jan. 1944 - 22 Jan. 1944, incl." (Hist. Div., S.G.O.).
- 52 Memo. to Dir., Dental Div., S.G.O., fr. Secy., M.D.T.C., 8 Jan. 1944, CONFIDENTIAL; subject: "Requirements of Equipment to be Installed on Mobile Dental Units" (A.M.R. & D. Bd.). Extracted in clear.
- 53 Memo. to M.D.E.L., fr. Research & Development Div., S.G.O., 12 Jan. 1944; subject: "Dental Operating Truck" (A.M.R. & D. Bd.).
- 54 Ltr. to M.D.E.L., fr. Dental Div., S.G.O., with Incl., 14 Jan. 1944; subject: "Dental Operating Truck" (M.D.E.L.).
- 55 Ltr. to S.G.O., fr. M.D.E.L., 14 Jan. 1944; subject: "Power Unit for Truck, 2 $\frac{1}{2}$ -ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).
- 56 Ltr. to Requirements Div., Hq., A.S.F., fr. Supply Service, S.G.O., 15 Jan. 1944; subject: "Unit Power, Electric;

PE-75-T" (A.M.R. & D. Bd.).

57 1st Ind. to S.G.O., fr. Requirements Div., A.S.F., 21 Jan. 1944; basic: see n. 56, p. 526 (A.M.R. & D. Bd.).

58 Monthly Narrative Report, M.D.E.L., 1 - 31 Jan. 1944, p. 14 (A.M.R. & D. Bd.).

59 Ltr. to Hist. Div., S.G.O., fr. M.D.E.L., 4 Dec. 1945; subject: "Truck, 2½-ton, Optical Repair Unit, Project F-32 and Truck, 2½, 6x6, Dental Operating, Project F-37, Histories of"; see Incl. 2, p. 6 (Hist. Div., S.G.O.).

60 Shipping Ticket, Richmond A.S.F. Depot to M.D.E.L., 24 Jan. 1944; subject: "Surgical Truck" (M.D.E.L.).

61 See n. 59, above, Incl. 2, p. 7.

62 See n. 58, above.

63 Ibid.

64 See n. 59, above, Incl. 2, p. 7.

65 Ibid.

66 Ltr. to S.G.O., fr. M.D.E.L., 21 Feb. 1944 (M.D.E.L.).

67 Monthly Narrative Report, M.D.E.L., 1 - 29 Feb. 1944, p. 14 (A.M.R. & D. Bd.).

68 Ltr. to M.D.E.L., fr. S.G.O., 26 Feb. 1944 (M.D.E.L.).

69 See n. 67, above.

70 Ltr. to M.D.E.L., fr. Dental Div., S.G.O., 14 Jan. 1944, with Incl. (M.D.E.L.).

71 Memo. to M.D.E.L., fr. Post Dental Surgeon, Carlisle Bks., Pa., 7 Mar. 1944; subject: "Dental Operating Unit" (M.D.E.L.).

72 Ltr. to S.G.O., fr. M.D.E.L., 7 Mar. 1944; subject: "Truck, 2½-Ton, 6x6, Dental, Operating" (M.D.E.L.).

73 Memo. to Supply Service, S.G.O. (Thru: Technical Div., S.G.O.), fr. Dental Div., S.G.O., 11 Mar. 1944 (A.M.R. & D. Bd.).

74 Memo. to Chf., M.D.T.C., fr. Technical Div., S.G.O., 28 Feb. 1944; subject: "Truck, 2½Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).



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75 Memo. to Chf., Supply Service, S.G.O., fr. Technical Div., S.G.O., 1 Mar. 1944; subject: "Data for New Nonexpendable Item - Truck, 2½-Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).

76 1st Memo. Ind. to Technical Div., S.G.O., fr. Supply Service, S.G.O., 3 Mar. 1944; basic: see n: 75; above (A.M.R. & D. Bd.).

77 Ltr. to S.G.O., fr. Air Surgeon's Office, Hq., A.A.F., 6 Mar. 1944, CONFIDENTIAL; subject: "Requirements on Truck; 2½-ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).  
Extracted in clear.

78 Ltr. to M.D.T.C., fr. Subcommittee of Medical Dept. Technical Committee, 3 Mar. 1944, CONFIDENTIAL; subject: "Medical Department Technical Subcommittee Report on: Truck, 2½-Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).  
Extracted in clear.

79 Min. of M.D.T.C., 6 Mar. 1944, RESTRICTED (Hist. Div., S.G.O.). Extracted in clear.

80 Memo. to Dir., Technical Div., S.G.O., fr. Chf., Catalog Br., Supply Service, S.G.O., 14 Mar. 1945; subject: "New Catalog Item Listing" (A.M.R. & D. Bd.).

81 Supra., p. 505.

82 Ltr. to C.G., A.S.F., fr. S.G.O., 8 Mar. 1944, CONFIDENTIAL; subject: "Truck, 2½-Ton, 6x6, Dental, Operating" (Rec. Rm., S.G.O., 451.2). Extracted in clear.

83 2d Ind. to S.G.O., fr. Requirements Div., Hq., A.S.F., 16 Mar. 1944, CONFIDENTIAL; basic: see n. 82, above (A.M.R. & D. Bd.). Extracted in clear.

84 Memo. to Chf., Organization & Equipment Allowance Br., Technical Div., S.G.O., fr. Chf., Research Coordination Br., Technical Div., S.G.O., 28 Mar. 1944, CONFIDENTIAL; subject: "Truck, 2½-Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.). Extracted in clear.

85 Memo. to Chf., Operations Service (Attention: Dir., Technical Div.), S.G.O., fr. Chf., Catalog Br., Supply Service, S.G.O., 25 Mar. 1944, CONFIDENTIAL; subject: "Truck, 2½-Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).  
Extracted in clear.

86 See n. 84, above; also see Memo. Routing Slip to Maj. Lipton, 28 Mar. 1944 (A.M.R. & D. Bd.).

87 Memo. to Chf., Supply Service, S.G.O., fr. Dir., Technical Div., S.G.O., 7 Apr. 1944; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6x6, Dental Operating" (A.M.R. & D. Bd.).

88 Ltr. to C.G., A.S.F., fr. S.G.O., 28 Mar. 1944; subject: "Request for Change in Basis of distribution for Truck, 2 $\frac{1}{2}$ -Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).

89 See n. 86, p. 528.

90 1st Ind. to S.G.O., fr. Dir., Plans & Operations, Hq., A.S.F., 31 Mar. 1944; basic: see n. 88, above (A.M.R. & D. Bd.).

91 1st Ind. to M.D.E.L., fr. S.G.O., 13 Apr. 1944; basic: ltr. to S.G.O., fr. M.D.E.L., 7 Mar. 1944; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6x6, Dental, Operating" (M.D.E.L.).

92 1st Ind. to S.G.O., fr. A.M.P.O., 26 Apr. 1944; basic: not cited (A.M.R. & D. Bd.).

93 Transmittal Sheet to Development Br., Technical Div., S.G.O., fr. Chf., Supply Coordination Br., Technical Div., S.G.O., 2 May 1944, with Incls. (A.M.R. & D. Bd.).

94 Memo. to Chf., Supply Service, S.G.O., fr. Dir., Technical Div., S.G.O., 24 May 1944; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6x6, Dental, Operating" (A.M.R. & D. Bd.).

95 1st Ind. to Hist. Div., S.G.O., fr. A.M.P.O., 31 Oct. 1945; basic: ltr. to A.M.P.O., fr. Hist. Div., S.G.O., 22 Oct. 1945 (Hist. Div., S.G.O.).

96 Ltr. to S.G.O., fr. Dir., M.D.E.L., 26 Jun. 1944; subject: "Amendment-1 to M.D.E.L.T.S. No. 108-A, Truck, 2 $\frac{1}{2}$  Ton, 6x6, Dental Operating" (A.M.R. & D. Bd.).

97 A.G. ltr. to Commanders of all theaters, defense commands, departments, and bases overseas, 22 Sep. 1944; subject: "Item 99588-05, truck, 2 $\frac{1}{2}$ -ton, 6x6, dental operating" (A.M.R. & D. Bd.).

98 1st Ind. to Hist. Div., S.G.O., fr. A.M.P.O., 31 Oct. 1944; basic: ltr. to A.M.P.O., fr. Hist. Div., S.G.O., 22 Oct. 1944 (Hist. Div., S.G.O.).

99 Ibid.

1 Ltrs. to C.G., POA; C.G., NATOUSA; C.G., CBI; C.G., So. Pac. Base Cmd; C.G., ETO; and C.G., SWPA, fr. Chf., Supply Service, S.G.O., 26 Oct. 1944; CONFIDENTIAL; subject: "Medical Department Trucks" (Rec. Rm., S.G.O., 451.2).  
Extracted in clear.



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<sup>2</sup>Memorandum Report on: Mobile Dental Operating Units, 11 Feb. 1944, A.A.F., Materiel Command, Engineering Division, Aero Medical Laboratory, Serial Number ENG-49-698-26 (A.M.R. & D. Bd.).

<sup>3</sup>Memorandum Report on: Mobile Dental Operating Units, 7 Oct. 1944, A.A.F. Air Technical Service Command, Aero. Medical Laboratory, Serial Number TSELA-5B-698-26A (A.M.R. & D. Bd.).

<sup>4</sup>See n. 2, above. The discussion which follows is drawn from this 11 February 1944 Report.

<sup>5</sup>See n. 3, above.

<sup>6</sup>Memo. to Dir., Technical Div., S.G.O., fr. Development Br., Technical Div., S.G.O., 10 Jul. 1944; subject: "Visit to Wright Field, Dayton, Ohio, on 9 July 1944" (A.M.R. & D. Bd.).

<sup>7</sup>Date of standardization of Medical Department model - 16 March 1944; see 2d Ind. to S.G.O., fr. Requirements Div., A.S.F., 16 Mar. 1944; basic: ltr. to Hq., A.S.F., fr. S.G.O., 8 Mar. 1944 (A.M.R. & D. Bd.). Date of original procurement order for Medical Department model - 17 June 1944; see 1st Ind. to Hist. Div., S.G.O., fr. A.M.P.O., 31 Oct. 1945; basic: ltr. to A.M.P.O., fr. Hist. Div., S.G.O., 22 Oct. 1945 (Hist. Div., S.G.O.).

Date of inspection by Medical Department of Aero Medical Laboratory model - 9 July 1944; see Memo. to Dir., Technical Div., S.G.O., fr. Development Br., Technical Div., S.G.O., 10 Jul. 1944; subject: "Visit to Wright Field, Dayton, Ohio, on 9 July 1944" (A.M.R. & D. Bd.).

<sup>8</sup>See n. 6, above.

<sup>9</sup>Ibid.

<sup>10</sup>Ltr. to C.G., A.A.F. (Attention: A.A.F. Board Control Office), fr. Pres., A.A.F. Board, Orlando, Fla., 12 Jan. 1945; subject: "Mobile Dental Operating Units" (Rec. Rm., S.G.O., 451.2 Carlisle Bks.-N).

<sup>11</sup>See n. 3, above.

<sup>12</sup>The Air Surgeon's Bulletin, Dec. 1944, Vol. I, No. 2, RESTRICTED, p. 7. Extracted in clear.

<sup>13</sup>See n. 10, above.

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- 14 1st Ind. to Dir., Medical Field Service Lab., Carlisle, Pa. (Thru: C.G., Hq., A.S.F.), (Attention: Dental Div., S.G.O.), fr. Chf., Supply Div., Air Surgeon's Office, Hq., A.A.F., 23 Jan. 1945; basic: see n. 10, p. 530 (Rec. Rm., S.G.O., 451.2 Carlisle Bks.-N).
- 15 2d Ind. to Dir., Medical Field Service Lab., Carlisle, Pa., fr. Dental Div., S.G.O., 6 Feb. 1945; basic: see n. 10, p. 530 (Rec. Rm., S.G.O., 541.2 Carlisle Bks.-N).
- 16 Memo. to Hq., 2d Service Command, A.S.F., Governors Island, N.Y., fr. Regional Hosp., Ft. Jay, N.Y., 1 Feb. 1945 (A.M.R. & D. Bd.).  
Memo to Dental Surgeon's Office, Hq., 2d Service Command, A.S.F., Governors Island, N.Y., fr. Medical Supply Office, Regional Station Hosp., Ft. Jay, N.Y., 5 Feb. 1945 (A.M.R. & D. Bd.).
- 17 1st Wrapper Ind. to S.G.O., fr. M.D.E.L., 7 Mar. 1945; basic: not cited (A.M.R. & D. Bd.).
- 18 Ibid.
- 19 1st Memo. Ind. to Dir., Dental Div., S.G.O., fr. Dir., Technical Div., S.G.O., 17 Mar. 1945; basic: not cited (A.M.R. & D. Bd.).
- 20 Ltr. to Post Dental Surgeon, Ft. Sheridan, Ill., fr. H. F. Olson, Capt. D. C., 1612 SC Station Medical Activities, Ft. Sheridan, Ill., undated; Incl. 1 of Ltr to M.D.E.L., fr. S.G.O., 14 May 1945; subject: "Mobile Dental Operating Unit" (A.M.R. & D. Bd.).
- 21 1st Ind. to S.G.O., fr. M.D.E.L., 6 Jun. 1945; basic: ltr. to M.D.E.L., fr. S.G.O., 14 May 1945; subject: "Mobile Dental Operating Unit" (A.M.R. & D. Bd.).
- 22 Interview with Col. Rex McK. McDowell, D.C., Dental Div., S.G.O., 19 Feb. 1946.
- 23 Ltr. to S.G.O., fr. The Commandant (FS-P), U.S. Coast Guard, Washington, D.C., 19 Jun. 1945; subject: "Dental Operating Truck, 2½ ton, 6x6, request for" (Rec. Rm., S.G.O., 451.2).
- 24 Essential Technical Medical Data and Annual Reports, Calendar Year 1945 (Hist Div., S.G.O.).
- 25 Ltr. to Asst. Surgeon, Medical Sec., Hq., 12th Air Force, APO 650, fr. Office of The Air Surgeon, Hq., 12th Air Force, APO 650, 1 Nov. 1943; subject: "Development of Mobile Dental Unit;" appears as Appendix I, Part C, to

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Memorandum Report on: Mobile Dental Operating Units, 11  
Feb. 1944, A.A.F. Materiel Command, Engineering Division,  
Aero Medical Laboratory, Serial Number ENG-49-698-26  
(A.M.R. & D. Bd.).

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## CHAPTER X

TRUCK, 2 $\frac{1}{2}$ -TON, 6 X 6, SURGICAL OPERATINGI. The Auxiliary Surgical Group.

Since the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating was developed as organizational equipment for use by certain components of the numbered Auxiliary Surgical Groups, the narrative of its development will doubtless have more meaning if a brief explanation of the composition and mission of an auxiliary surgical group is given first.

Typical of its kind was the Second Auxiliary Surgical Group, which was active in North Africa, Italy, and Southern France. According to one of its annual reports, an auxiliary surgical group, "a Theater reserve unit," is "composed of a group headquarters, general surgical, orthopedic, neuro-surgical, thoracic and maxillo-facial surgical teams, shock, gas, dental prosthetic and miscellaneous teams" which, though they operate primarily in Army and Corps installations, may be "attached to Base Sections, Task Forces, Hospital Ships, Divisional Clearing Stations and Ranger Battalions."<sup>1</sup> The function of these highly specialized and well-trained units is "to supplement the regular Medical and Dental surgical services during periods of peak loads and to provide a flexible and mobile method of augmenting" other Medical installations "when the tactical situation demands it."<sup>2</sup> Furthermore, they usually function far forward, for "Approximately 80% of their employment"--in the experience of the Second Auxiliary Surgical Group, at least--"has been in field hospitals set up to do non-transportable casualties, adjacent to clearing stations."<sup>3</sup>

It was for the use of these professional service teams, teams designed to "reinforce any medical installation or unit requiring additional surgical facilities or personnel in a theater of operations,"<sup>4</sup> then, that the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating (Development Project, F-35) was designed.

II. Project Initiation.

According to a contemporary newspaper account, the need for a specially designed surgical operating truck--a vehicle much more elaborate than the surgical truck that had been developed and standardized nearly nine months before for use

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by the armored divisions<sup>5</sup> occurred to The Surgeon General in May 1943 during an inspection tour of the North African battle area.<sup>6</sup>

To substantiate the ideas of The Surgeon General, the Field Equipment Development Branch on 25 June 1943 requested of the Research Coordination Branch "that a research project be established for the revision of the contents and arrangements contained in the present 2 $\frac{1}{2}$ -ton, 6 x 6 Truck, Surgical" and explained that "This is necessary in order to provide an operating truck desired by General Kirk for use by the Auxiliary Surgical Group."<sup>7</sup> The Field Equipment Development Branch further indicated that "This development has been coordinated with the Office of The Quartermaster General and a tent is being designed by them based on the desires expressed by General Kirk" in a conference, attended by the Director of the Medical Department Equipment Laboratory, held 22 June 1943.<sup>8</sup>

Simultaneous with this intraoffice request, The Surgeon General's Office formally asked The Quartermaster General to establish a project to develop a suitable tent for use with the proposed Medical Department vehicle and to authorize direct communication between the Office of The Quartermaster General and the Medical Department Equipment Laboratory until completion of the project.<sup>9</sup>

Acting promptly upon the request of the Field Equipment Development Branch, the Research Coordination Branch of The Surgeon General's Office obtained from Headquarters, Army Service Forces--apparently by telephone--authority to proceed with the project and to spend on it \$1,000 of research funds.<sup>10</sup> When this request was formally handled two days later, however--on 30 June 1943--Headquarters, Army Service Forces, temporarily withheld its approval until The Surgeon General's Office could clarify its proposal to use the standard surgical truck as the basis for the contemplated surgical operating truck for the auxiliary surgical group.

In its letter of 30 June 1943 to The Commanding General, Army Service Forces, The Surgeon General's Office explained that the Medical Department at that time had a Truck, Surgical, which had been standardized by Army Service Forces on 28 October 1942 for use by Armored Force medical battalions; that this truck "has a special body and equipment for the performance of limited surgery by the Bn. Surgeon in the truck"; and that with it was employed a special tent which "is pitched over the truck and used as a dressing station."<sup>11</sup> The Surgeon General's Office declared further, however, that "Reports from the field indicate need for a highly mobile surgical



truck to permit the performance of more extensive surgery in the forward areas"; that the development of such a truck at the Medical Department Equipment Laboratory was proposed, with the "standard 2½ ton 6 x 6 truck, without special body" being "utilized as the basic vehicle"; and that "Necessary surgical equipment will be installed in the truck in a semipermanent (demountable) manner."12

"As discussed in telephone conversation with your office (Major Thomas) 28 June 1943," the letter concluded, "request authorization for initiation of subject project and expenditure of research funds in the amount of \$1000."13

By indorsement, Headquarters, Army Service Forces, indicated its belief that the development of the surgical operating truck, "is desirable if it will result in the elimination of the special body vehicle [the Truck, 2½-Ton, 6 x 6, Surgical] mentioned ... in basic letter."14 Since "The Commanding General, Army Ground Forces, has indicated that there is possibility the truck, surgical, with special body designed for use by the Armored Force Medical Battalion can be replaced by the vehicle proposed for development, provided development is successful," Headquarters, Army Service Forces, before giving its final approval of the proposed project, desired that "comments as to the possibility of eliminating the special vehicle be made" by The Surgeon General's Office "in order that this correspondence can be referred to the Armored Force."15

Thereupon followed a careful clarification of the relationship between the two special-purpose trucks. "It is contemplated utilizing the 2½-ton 6 x 6 truck with the type of body employed for the standard surgical truck as the basis of development of this item," The Surgeon General's Office explained; "Thus while the body is standardized in the sense that it is in present use, it is actually a special type body and not of conventional cargo type."16 Whereas the surgical truck used by the Armored Force "is in reality a mobile aid station, since its equipment is not highly elaborate and it provides space for surgical treatment within the body of the vehicle," The Surgeon General's Office continued, "The proposed surgical operating truck will have somewhat more extensive equipment, notably a sterilizer and a much larger reserve of surgical supplies."17 Consequently, although the basic bodies of the two trucks would be the same, "the installations will differ somewhat and treatment of patients will be carried on entirely outside the vehicle."18

Apropos of the suggestion that the new surgical operating

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truck, if successfully developed, might serve also as the special vehicle for the Armored Force. The Surgeon General's Office believed it possible "that the Armored Force may be able to employ the vehicle proposed for development by deletion of portions of the additional supplies and equipment" and felt that "If so this would eliminate the objection of having two special similar surgical trucks."<sup>19</sup> It was felt, nevertheless, that "there still will remain a need for a truck with a special body" inasmuch as "several possible uses of the same body as that employed for the surgical truck" were being considered by the Medical Department and because, further, "It is not believed possible to design a satisfactory surgical truck without employment of a special body."<sup>20</sup>

These comments having been rendered as directed, The Surgeon General's Office requested that Headquarters, Army Service Forces, approve the proposed project "with the understanding that close liaison will be maintained between the Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania, and Headquarters, Armored Force, Fort Knox, Kentucky," and promised that "Every attempt will be made to develop a vehicle which will be satisfactory both for the general use contemplated by this office and for employment by the Medical Battalion, Armored Force in lieu of the present standard surgical truck."<sup>21</sup> Apparently skeptical that one truck could be made to serve both purposes, The Surgeon General's Office concluded its request with this observation:

Even if this goal cannot be attained exactly, it is desired to emphasize the fact that experience in theaters of operations has demonstrated clearly the imperative need for a mobile surgical operating truck and further has demonstrated the fact that the present surgical truck is inadequate for the performance of more than very limited emergency surgical treatment. In short, the need is for mobile operating room facilities, whereas the present vehicle provides only emergency room facilities.<sup>22</sup>

On 9 July 1943, in consequence of this explanation, Headquarters, Army Service Forces, approved the "development of a Truck, 2½-Ton, 6 x 6, Surgical, Operating based upon the standard Truck, 2½-Ton, 6 x 6, Surgical (Armored Force)";<sup>23</sup> and on 13 July 1943 the Field Equipment Development Branch and the Surgical Division of The Surgeon General's Office were notified of this favorable action by higher authority.<sup>24</sup>

Until this moment, it will be observed, two important



provisions of AR 850-25 had either been ignored or overlooked both by The Surgeon General's Office and by Headquarters, Army Service Forces: (1) Military characteristics as such had not been formally determined, and (2) none of the actions resulting in approval of the project had been processed through either the Subcommittee or the Medical Department Technical Committee. Quite promptly thereafter, however, The Surgeon General's Office voluntarily rectified this irregularity when it initiated action to process military characteristics of the surgical operating truck in accordance with prescribed procedures.

On 2 August 1943 the Chief of the Field Equipment Development Branch requested the Medical Department Equipment Laboratory to submit tentative military characteristics of the proposed surgical operating truck;<sup>25</sup> the Equipment Laboratory complied five days later;<sup>26</sup> and the Field Equipment Development Branch, on 13 August 1943, informed the Research Coordination Branch that tentative military characteristics of the Truck, Surgical, Operating were as follows:

a. That the Truck, Surgical, Operating be an adaptation or conversion of the now standard Surgical Truck.

b. That the equipment for installation in the truck be designed and arranged to provide for the following:

(1) Storage space for the necessary material for a minimum of 80 surgical procedures.

(2) Adequate means for the scrubbing of arms and hands preparatory to the carrying out of surgical procedures.

(3) Adequate means for sterilizing the material necessary for surgical procedures.

c. The equipment shall be permanently installed in the truck.

d. Size and quantity of equipment shall be held to a minimum compatible with the operation of such a unit.<sup>27</sup>

On 23 August 1943 the Subcommittee on Field Equipment recommended that military characteristics as stated above be adopted for the Truck, Surgical, Operating;<sup>28</sup> and two weeks later, on 6 September, the Medical Department Technical Committee--except for changing the nomenclature to Truck, ~~2 1/2~~-Ton, 6 x 6, Surgical Operating--approved the report of its subcommittee.<sup>29</sup> Records of these actions were transmitted to the Commanding General, Army Service Forces, on 13 September 1943 with the request "that the recommendation by the Medical Department Technical Committee for adoption of military

characteristics... be approved."<sup>30</sup> After securing concurrence of the Army Ground Forces,<sup>31</sup> Headquarters, Army Service Forces, approved the statement of military characteristics for the Truck, 2½-Ton, 6 x 6, Surgical Operating.<sup>32</sup> And on 7 October 1943 the Research Coordination Branch notified other interested agencies within The Surgeon General's Office of the approval of Headquarters, Army Service Forces, and instructed the Field Equipment Development Branch to inform the Medical Department Equipment Laboratory of this action.<sup>33</sup>

Thus some 3½ months after the first formal suggestion that approval of the project by higher authority be sought, the initiation phase of Development Project, F-35, Truck, 2½-Ton, 6 x 6, Surgical Operating was properly completed in accordance with the provisions of AR 850-25. Developmental work on the project had meantime been progressing rapidly and smoothly. By the time that the statement of military characteristics of the truck was approved, indeed, The Surgeon General himself, along with some of his staff, as will be seen in the next section, had already inspected the pilot model at the Medical Department Equipment Laboratory.

### III. Development Phase.

Rapid development of the surgical operating truck was considered to be of such urgency that even before The Surgeon General's Office formally requested approval of the project several very practical but informal moves had been made to speed the development along.

#### A. Preliminary Steps.

On 15 June 1943, for example, the Field Equipment Development Branch requested the Distribution Division of The Surgeon General's Office to ship one Truck, 2½-Ton, 6 x 6, Surgical with its tentage to the Medical Department Equipment Laboratory "as soon as possible for the purpose of conducting experiments with reference to changes in the internal arrangement of the Truck, Surgical."<sup>34</sup> At the same time, in anticipation of the formal establishment of the project, The Surgeon General's Office directed the Equipment Laboratory to conduct experiments "to test the feasibility of changes in the Truck, 2½-Ton, 6 x 6, Surgical"<sup>35</sup>—modifications that were believed necessary to the successful development of a surgical operating truck based on the surgical truck in use by the Armored Force.

Although military characteristics of the proposed



vehicle had not as yet been determined, The Surgeon General's Office was able to make some very definite suggestions as to the changes which it desired:

a. Water tanks in the floor on either side and well toward the rear with an outside faucet toward the rear.

b. A pressure pump for the inside faucet in the sink at the front of the truck.

c. Large cabinets with doors for dressings and instruments on both sides of the truck.

d. Capable of holding sufficient material which has been sterilized for 80 to 100 operations.

e. A sterilizer in the front of the truck similar to the dried air sterilizer which is used by the British and French, who claim this is effective for sterilizing dressings.

f. Provision for field fluoroscopy unit. . . .

g. A sink in the front of the truck with foot control.

h. The tent which is to be carried in the truck shall have a double wall with room enough for two operating tables and a shock table with a tarpaulin floor.<sup>36</sup>

The tent, which was to be developed by the Quartermaster Corps, was to be designed, if feasible, so that it could be attached to the rear instead of spread over the top of the truck. The Surgeon General's Office intended, furthermore, that the new truck should "carry tentage for personnel assigned to the truck, approximately three officers and four enlisted men. (Two Pyramidal tents and four Command Post Tents.)"<sup>37</sup>

This directive from The Surgeon General to the Medical Department Equipment Laboratory concluded with the information that "One of the present model Surgical Trucks is being requested for your laboratory in order to enable you to conduct these experiments."<sup>38</sup>

One other preliminary step taken prior to approval of the development project was the request of the Field Equipment Development Branch that the Distribution Division

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ship an X-Ray Field-Unit, Fluoroscopic, complete with trunks and folding table to the Equipment Laboratory for use in the development of the surgical operating truck and that it send one of the 2½-ton 6 x 6 surgical trucks to the Jeffersonville Quartermaster Depot "for experimental use in connection with the development of a new Tent for the Auxiliary Surgical Group."<sup>39</sup> Although the idea of using the x-ray unit seems never to have materialized, it thus appears that at this time every possible anticipatory action was being taken to get the project quickly under way, once approval of Headquarters, Army Service Forces, had been secured.

B. Construction of the Pilot Model.

By the end of July the Medical Department Equipment Laboratory reported that the surgical truck requisitioned for conversion into the pilot model of the surgical operating truck had arrived on 30 July 1943 from the New York Ordnance District and that "Final plans regarding change in design and equipment to be installed in the truck, surgical, operating, are pending the arrival at this laboratory of Colonel Clinton S. Lyter, M. C., who is being ordered to this office for a two (2) weeks' period temporary duty in this connection."<sup>40</sup> At that time the Equipment Laboratory anticipated "that the work on the truck for the auxiliary surgical group will be completed in about ten days."<sup>41</sup>

When it learned that the truck had been delivered, The Surgeon General's Office promptly ordered Colonel Clinton S. Lyter, Commanding Officer, First Auxiliary Surgical Group, Fort Sam Houston, Texas, to the Medical Department Equipment Laboratory to "assist in the development of an operating truck for the auxiliary surgical groups."<sup>42</sup> On 10 August 1943 Colonel Lyter reached the Laboratory.<sup>43</sup>

During Colonel Lyter's tour of temporary duty, development of the new truck seems to have progressed quite well. The Equipment Laboratory reported at the end of August that "final plans regarding equipment to be installed" as well as design of the surgical operating truck had been completed; that conversion of a standard surgical truck into a surgical operating truck, except for the installation of one cabinet, had been "nearly completed"; and that a tentative list of equipment for the proposed unit had been forwarded at Colonel Lyter's request to The Surgeon General.<sup>44</sup> Although the surgical and medical supplies requisitioned had not yet been received, the Laboratory expected them to arrive within the week; and it indicated, in conclusion, that "the surgical truck, operating, will be completed and ready for inspection by The Surgeon General on or about 10 September 1943."<sup>45</sup>

Most of August and September was "spent in converting



the interior of the truck to meet the requirements set forth by Surgeon General's Office in their letter of 15 June 1945 and in requisitioning supplies";<sup>46</sup> nevertheless, few difficulties were encountered in structurally transforming the surgical into the surgical operating truck, into which all cabinets and interior equipment had been installed by 20 September 1943.<sup>47</sup> "Further development of this project," the Equipment Laboratory reported at the end of September, "is awaiting any changes which might evolve from the inspection which the Surgeon General is anticipated to make on October 4, 1943."<sup>48</sup> At the same time the Laboratory indicated that

The tent for the surgical truck, operating, which was constructed at the Jeffersonville Quartermaster Depot, Jeffersonville, Indiana, was received on September 27, 1943. It has been set up and inspected by the personnel of this Laboratory and is now ready for inspection by the Surgeon General.<sup>49</sup>

C. Inspection by The Surgeon General.

The Surgeon General, accompanied by two general officers of his staff, inspected the pilot model of the truck and tent, as anticipated, on 4 October 1943<sup>50</sup>—just a few days prior to Army Service Forces' approval of the military characteristics of the unit. Although several of his decisions necessitated much additional work, some of which was not strictly developmental, The Surgeon General in the main was "quite pleased" with both the truck and the tent.<sup>51</sup>

1. Proposed Modification of the Tent.

One result of The Surgeon General's visit was a proposal to modify the surgical operating tent. In one account of the inspection the Equipment Laboratory stated that roof ventilators in the tent liner were also to be provided.<sup>52</sup> Its Monthly Narrative Report for October, however, made no reference to this proposed change; it indicated, instead, that the design and construction of the tent had been approved by The Surgeon General "with the exception that a decrease in width of the tent by two panels and the addition of a blackout entrance was directed."<sup>53</sup> Since formal development of the tent was a responsibility of the Quartermaster Corps rather than of the Medical Department, these changes are mentioned briefly and only incidentally.

2. Liaison with Armored Force.

A second result of The Surgeon General's

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inspection was further liaison with the Armored Force-- liaison which the Medical Department had promised Headquarters, Army Service Forces, to maintain while the surgical operating truck was being developed. On 5 October 1943 the Medical Department Equipment Laboratory wrote as follows to the Headquarters of the Armored Force:

General Kirk was here yesterday to see the new model Surgical Auxiliary Truck and Tent and seems quite pleased with both. A few tent modifications somewhat along your suggestions and which we had supposed the QM was putting in, i. e. proper blackout entrance and roof ventilators in the inner liner, have been made. He now wants you to see the new inside truck set up, as he believes that it is much better than your present surgical truck, especially since you do not want to use a table in it.

This one is made up to carry supplies and equipment. The General wants to concentrate on one model if possible. He asked me to write you and have you come up to see this one as soon as possible.<sup>54</sup>

About two weeks after this request, the Surgeon of the Armored Force inspected the surgical operating truck at the Medical Department Equipment Laboratory to determine the feasibility of using it in lieu of the surgical truck developed initially for the armored divisions. In a recorded interview he indicated that the new unit, despite the desirability of several of its features, would be inadequate for his needs, mainly because the mission of the armored medical battalions differed from that of the surgical auxiliary groups.

More specifically, although the "two layer" tent was "satisfactory" and other features highly commended the vehicle for use by the auxiliary surgical groups, the Armored Force Surgeon was convinced that his adoption of the new surgical operating truck would not give armored units "enough flexibility in field work."<sup>55</sup> Not only could he anticipate the occasional need "of doing work in these surgical trucks before the surgical tent is heated," but he also felt that the armored medical battalions would

need a place to do a few operations when the situation so requires, rather than be compelled to unpack and set up the tent complete which would be the case if we accepted the truck set-up. I

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also feel that there will be many times when one or two operations will be required while enroute behind a unit going into position. Under these circumstances it would be desirable to utilize one truck and use the interior thereof for such operative procedure.

Otherwise, the truck can be taken complete except that I would like to have the dome light, the operating light, left in for our units. The bins are excellent for the auxiliary surgical group, but would not permit sufficient space for any operative work in the truck. I therefore think our present arrangement is for the armored medical battalion more satisfactory. . . . 56

Copies of this recorded interview having been transmitted by the Director of the Plans Division to the Executive Officer and to other interested agencies within The Surgeon General's Office, all thought of developing a unit to be used by both the Armored Force and the auxiliary surgical groups then seems to have been dismissed.

### 3. Decision Relative to Service Test Models.

A third decision resulting from The Surgeon General's inspection of the pilot model--one that affected procurement ultimately more than it did development--was that 12 additional surgical trucks should be converted as soon as possible by the Medical Department Equipment Laboratory into service test models of the surgical operating truck. In asking The Surgeon General's Office to requisition the surgical trucks and equipment necessary for such an undertaking, the Equipment Laboratory explained on 7 October 1943 that the conversion could be performed "more expeditiously than attempting to have vehicle standardized for procurement now."<sup>57</sup> Inspection of the newly developed unit by the Armored Force not yet having occurred, the Laboratory observed that "Standardization can be taken up later with a view of having the Armored Command also adopt this new model in lieu of their present "surgical truck"; and it added that "Surgical auxiliary trucks, it is expected, will be very limited in number unless adopted by the Armored Force."<sup>58</sup>

Upon receipt of this letter from the Medical Department Equipment Laboratory, The Surgeon General's Office promptly initiated these two appropriate actions: (1) It requisitioned the 12 trucks and certain equipment needed by the Laboratory in effecting the proposed conversion;<sup>59</sup> and

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(2) it instituted the procedure required by AR 850-25 to have the 12 trucks approved as service test models by Headquarters, Army Service Forces.<sup>60</sup>

Transformation of the surgical trucks into surgical operating trucks was "immediately initiated" when the vehicle requisitioned through The Surgeon General's Office were delivered to the Laboratory on 22 November 1943, at which time it was estimated that the conversion would be completed within approximately two months.<sup>61</sup> Following favorable consideration by both the Subcommittee and the Medical Department Technical Committee,<sup>62</sup> furthermore, the second of these two actions was subsequently terminated after Headquarters, Army Service Forces, on 6 December 1943, returned to The Surgeon General this approving indorsement:

1. The item, Truck,  $2\frac{1}{2}$ -Ton, 6 x 6, Surgical operating is classified as follows:

Required type

Development type

Service test type.

2. The conversion of 12 standard surgical trucks (Item No. 99590) into service test models together with expenditure of research funds in the amount of \$12,000 for the conversion and \$9,072 for trailers, tents and generators is authorized.<sup>63</sup>

4. Industrial Development of Sterilizer.

Another result of The Surgeon General's inspection of the pilot model on 4 October 1943 was an intensified effort by industry, working closely with the Medical Department Equipment Laboratory, to develop for the surgical operating truck a suitable sterilizing unit for dressings and bandages. This activity began on 7 October 1943, when the Laboratory requested from The Surgeon General's Office authority "to have the American Sterilizer Company furnish twelve (12) experimental, small sterilizers for use in these trucks, to be built according to specifications desired by General Kirk."<sup>64</sup> The Laboratory explained that "These sterilizers if found satisfactory, [were] to be later standardized as Item 99500, Sterilizer, Dressing and Utensil, in lieu of the present model which is not very portable."<sup>65</sup>

On 23 October 1943 the American Sterilizer Company initially proposed to the Medical Department Equipment Laboratory that a jet steam-heated hot water system



and sterilizer combined be employed on the surgical operating truck.<sup>66</sup> Acknowledging receipt of the manufacturer's drawing illustrating the proposed layout, the Equipment Laboratory promptly replied that

The plan appears feasible, and it is proposed to send the truck up to Erie for a period of approximately five days for installation and test there, the truck to be sent when materials for installation are ready.

This is your authorization to proceed with the manufacture of the pilot unit to consist of complete sterilizer unit and hot water tank including gasoline burner. Purchase order will be forwarded upon completion of the unit and when cost is determined.<sup>67</sup>

As originally designed, the sterilizer-hot water assembly consisted essentially of the following components: (1) "a standard 16 x 24" dressing sterilizer" mounted at a slight angle on the counter in a corner of the truck, "leaving just clearance enough at the front end for the swing of the door"; and (2) "a 12" copper boiler, properly jacketed," to which would be applied "A standard Coleman gasoline stove, having 3-10,000 b. t. u. burners."<sup>68</sup> The company's representative also suggested an "arrangement of the hot water tank somewhat different than the one you have been using, which we believe can be very simply mounted, and which should simplify your piping."<sup>69</sup> He explained further that

The heating of the water will be accomplished through a long copper tube, properly restricted at the discharge end, so that the condensate of the heating steam will pass directly into the hot water tank, thereby conserving the heat which would otherwise be wasted if we applied the conventional coil with the steam trap.<sup>70</sup>

The designer intended for the boiler to be operated, finally, "at approximately 25 pounds steam pressure, and the dressing sterilizer at 15-18 pounds steam pressure, utilizing a steam control valve inside the truck."<sup>71</sup> The "excess of steam pressure in the boiler," he said, "will produce smoother operation of the dressing sterilizer."<sup>72</sup>

On 15 November 1943 the pilot model of the surgical operating truck was driven to the factory of the

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American Sterilizer Company at Erie, Pennsylvania, for installation of the sterilizer-hot water assembly. When the work was completed a few days later, the manufacturer reported that

The truck is now equipped with:

One 16 x 24" Model V (steel construction hot dipped galvanized) steam-heated American Dressing Sterilizer.

One Hot Water Heat Exchanger and Tank approximately 6" in diameter and 50" in length.

One Copper Boiler, gasoline heated, by means of a Coleman Burner having a capacity of either 30,000 or 40,000 BTU, arranged for mounting outside the truck, and complete with safety valve, steam gauge, fill-in funnel and valve gauge glass, and a jacket made of steel, asbestos lined, double wall construction.

The price of this equipment, mounted in the truck at our plant is \$730.25 net.

For additional units, complete as outlined above, but not installed, and without interconnecting piping, but complete with all valves, traps, etc, we can furnish this equipment complete as described for \$541.40 per set f. o. b. Erie, Pa., in lots of ten or more.<sup>73</sup>

On 25 November 1943 the Medical Department Equipment Laboratory authorized the American Sterilizer Company "to proceed with the construction of 12 units"; at the same time it specified, however, that "These sterilizers are to be Everdur with the door brass castings instead of galvanized steel."<sup>74</sup> Simultaneously, the Medical Supply Officer, Carlisle Barracks, told the manufacturer that "this office can give AA-1 Preference Rating" for this equipment.<sup>75</sup>

Taking cognizance of the proposed change in specifications, the American Sterilizer Company promptly informed the Laboratory that

The additional cost per unit in lots of ten or more will be \$97.00 making a total cost per unit in this quantity of \$638.40, net, f. o. b. Erie, Pa.



We are further assured by our factory that production can be scheduled to insure delivery in the vicinity of 30 to 45 days after receipt of order.<sup>76</sup>

Thus it is apparent that the original intention was to equip the twelve service test models with a combination sterilizer and hot water system that was identical--if not in material, at least in design--to that which had been installed on the pilot model surgical operating truck destined shortly to be field tested by both the Fourth and the Fifth Auxiliary Surgical Groups. Nevertheless this original plan was almost immediately modified.

As soon as the pilot model truck with its newly installed "experimental steam generator, water heater and sterilizer" had been returned from the factory to the Equipment Laboratory on 23 November 1943, tests had been "immediately initiated to determine the suitability of the equipment in question."<sup>77</sup> Although "Final conclusion in this regard has not yet been reached," the Laboratory reported at the end of November, "it is very probably from preliminary findings that the unit will not be considered suitable."<sup>78</sup> Those responsible for the development subsequently changed the design "from a jet steam heated water system and sterilizer unit to a separated system using a coil to heat the water and a knock down sterilizer utilizing gasoling heat."<sup>79</sup>

The reason for this change, explains an officer of the Equipment Laboratory who was instrumental in the development, "was not that the first system didn't work but rather that it was inefficient and worked too slow."<sup>80</sup> Just how efficient it had been is revealed in the following memorandum reporting results of the operational engineering tests performed by the Laboratory:

1. The heating plant of the Surgical Truck consists of the following:
  - a. 1 each 4 burner gasoline stove, 40,000 BTU.
  - 1 each Steam Generator and Fittings.
  - 1 each Hot Water Tank (6 gal) with Piping and Heating tube.
  - 1 each 24 x 14 inches galvanized horizontal Steam Sterilizer with piping.
2. To operate the unit it is necessary to fill the generator 3/4 full of water then start the burner. It usually takes 20-40 minutes to obtain

steam.. Once steam has been obtained water can be heated 100° F. in three minutes. This is done by allowing steam to bubble through 9 vent holes located in the heater tube. The sterilizer can be used in approximately one hour after starting and both the hot water heater and sterilizer can be operated at the same time. The following table will show the operation of the unit:

Time to obtain steam from cold start	20-40 minutes
--------------------------------------	---------------

Time first steam can be used for heating water	30-45 minutes
--	---------------

Time elapsed from cold start before sterilizer can be used	55-70 minutes
--	---------------

1 filling of generator with water last [ s ]	4 hours
--	---------

1 filling of gasoline stove last [ s ]	5 hours
--	---------

Once unit is heated up hot water is available at all times regardless of use. Sterilizers and hot water heater can be used simultaneously if steam valve to hot water tank is cracked (only). From a warm start the time periods are cut to about  $\frac{1}{2}$  the above figures.

3. The unit has the following disadvantages.

- a. Weight concentrated front right.
- b. Generator protrudes beyond body 3 inches.
- c. Piping became complicated due to both cold and hot water lines as well as steam lines. Obviously this allows greater change of holes [sic].
- d. Both hot water system and sterilizer dependent on one source of heat, Coleman gasoline stove.
- e. Unit is slow to operate (1 hour) from cold start and will operate only 4 hours on initial charge of water.

4. The unit has the following advantages:

- a. Brings all operations within truck without



any exhaust fumes.

- b. Heats water very fast and maintains high temperature.<sup>81</sup>

Because of the Equipment Laboratory's dissatisfaction over the combination sterilizer and hot water heater, the American Sterilizer Company was apparently asked to put a hold order on the 12 units intended for use in converting the surgical trucks to surgical operating.<sup>82</sup> Sterilizers of a design acceptably modified were later installed on the 12 converted surgical operating trucks before they were shipped overseas.<sup>83</sup>

D. Preparation of Equipment List.

Prior to, concurrent with, and even extending beyond some of these actions that resulted from The Surgeon General's inspection of the pilot model truck on 4 October 1943 was the combined effort of several Medical Department agencies to compile a list of appropriate equipment--principally medical and surgical--that would be needed in operating the truck.

A tentative list of equipment, one may recall, was first submitted on 25 August 1943 by the Commanding Officer of the First Auxiliary Surgical Group while he was detailed to the Equipment Laboratory to aid in the early development of the surgical operating truck.<sup>84</sup> This list was properly coordinated within The Surgeon General's Office.<sup>85</sup> Then the Chief of Surgical Service and the Assistant Chief Surgical Nurse of the 51st Evacuation Hospital were sent to the Equipment Laboratory on temporary duty "to supervise the packing of the pilot model surgical truck"<sup>86</sup> and thus determine practically the equipment that they believed should be included.

On 22 October 1943 these two visiting officers submitted to the Director of the Medical Department Equipment Laboratory a report on the method they had employed in conducting their tests, together with lists of recommended equipment (see Appendix M). There followed a great deal more of coordinative activity, both before and after field testing of the pilot model,<sup>87</sup> until on 22 January 1944 an "official list" (see Appendix N) was ready for publication by The Surgeon General's Office.<sup>88</sup>

E. Description of Pilot Model.

A tentative list of equipment having been prepared and the combined sterilizer and hot water system having been

installed at the factory of the American Sterilizer Company, the pilot model of the surgical operating truck was ready for field testing. Reports of the tests conducted will be considered directly; but first let us review the following extract from a typed memorandum among the records of the Research Coordination Branch of the now-dissolved Technical Division--a memorandum unidentified by date, authorship, or otherwise except by title--which succinctly describes both the mission and the physical characteristics of the newly developed mobile unit (see Figure 35):

The 2 $\frac{1}{2}$ -ton, 6 x 6, Surgical, Operating Truck consists of a 2 $\frac{1}{2}$ -ton, 6 x 6, Ordnance chassis with van body equipped with special cabinets and accessories [see Figure 36]. It is supplemented by a 1-ton trailer, a surgical operating tent, and a 2.5 KW motor generator. The truck is packed with sufficient general surgical instruments to perform approximately one hundred major surgical operations. When the supplementary sets provided to special surgical teams are added, it is suited for all types of surgery. In use, the tent is attached to the rear of the truck and serves as an operating arena for the two teams [see Figure 37], while the truck serves as a supply and sterilizing room. The generator provides all electrical energy required by the unit. This assembly is intended to supplement the operating facilities of an Evacuation or Field Hospital. It is not designed to operate alone since neither mess facilities nor bed capacity is included.<sup>89</sup>

F. Field and Operational Testing.

Beginning in the second half of December 1943 and continuing for several months thereafter, the pilot model of the surgical operating truck was tested first by the Fourth and later by the Fifth Auxiliary Surgical Group.

1. Decisions Resulting from Equipment Laboratory Tests.

Meantime, however, as reported by the Medical Department Equipment Laboratory at the end of December,

A pilot model of the surgical truck with



experimental steam generator, water heater and sterilizer was thoroughly tested [by the Equipment Laboratory] and conclusion reached that the combination of the water heater and sterilizer was not practical, and it was decided that in the twelve (12) surgical trucks now being outfitted at this station, the water heater and sterilizer will be separate units.<sup>90</sup>

The Laboratory reported further that the structural conversion of the twelve trucks was nearing completion; that with receipt of a "new list of equipment" on 15 December 1943, "requisition for supplies necessary to outfit the twelve (12) surgical trucks, operating, under construction" had been "immediately initiated"; and that "Completion of these units is . . . anticipated on 1 February 1944."<sup>91</sup>

2. Testing by Fourth Auxiliary Surgical Group.

The report just referred to--the report of activities of the Medical Department Equipment Laboratory during the month of December 1943--concludes with the information that

The pilot model surgical truck, operating, with trailer was forwarded to the Fourth Auxiliary Surgical Group, Lawson General Hospital, Atlanta, Georgia, for service test, leaving this station on 18 December 1943. This truck arrived at Atlanta, Georgia, on 21 December 1943.<sup>92</sup>

A letter from The Surgeon General's Office to the Commanding General of the hospital recommended "that the Truck, 2½-Ton, 6 x 6, Surgical, Operating, be set up besides your hospital and function under actual operating conditions for a short period of ten (10) days to two weeks" and "that a report be furnished this office with reference to the use of this Truck by 20 January 1944, upon the receipt of which steps will be taken to standardize the vehicle."<sup>93</sup> Another letter from the Director of the Medical Department Equipment Laboratory to the Commanding Officer of the Fourth Auxiliary Surgical Group transmitted "instructions for the steam generator, hot water system and steam sterilizer. . . , photographs of the tent . . . , and an instruction booklet on the generator unit," as well as a tentative list of equipment with the suggestion that such shortages of equipment as existed at the time of shipment from the Laboratory "should be requisitioned locally prior to tests."<sup>94</sup>

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On 17 January 1944 the Fourth Auxiliary Surgical Group submitted through channels to The Surgeon General a carefully prepared, comprehensive, and objective report on its field and operational testing of the pilot model surgical operating truck. Since the complete text is presented as Appendix O of this monograph, only a summary of the report is introduced at this time.

The truck underwent a road test by being driven, "fully loaded with trailer attached," from Carlisle Barracks, Pennsylvania, to Atlanta, Georgia, and examination of its contents upon arrival revealed that "not a single bottle was broken and so far as could be determined, none of the items were damaged by the trip."<sup>95</sup> Although no permanent damage resulted, it was nevertheless observed that, "due to inadequate drainage, the faucets in the rear of the truck, the condensation float on the sterilizer and the foot pedal under the sink were frozen."<sup>96</sup>

With the surgical operating unit "set up between two wards of Lawson General Hospital," the Fourth Auxiliary Group, using "only the equipment carried in the truck," actually performed twelve operations and found that "For the most part, the unit functioned in an excellent manner."<sup>97</sup>

The instruments provided were "adequate in both number and type";<sup>98</sup> the hot air heater and fan were "quite efficient" and the small electric generator "ran several days at a time without difficulty, and supplied sufficient power for all needs";<sup>99</sup> and the tent provided "adequate space to allow two teams to work without crowding."<sup>1</sup> Although "Weather conditions during the days when operations were actually performed were anything but ideal, consisting of rain, wind and, at times, sub-freezing temperatures," the pilot model then was "both warm and dry so that neither the patients nor the surgeons suffered any discomfort."<sup>2</sup>

The test report indicated, too, that illumination would be ample if only two instead of three field operating lamps were used; it recommended only minor modification of the litter supports; and though it stated that screened windows "would be a distinct advantage if the unit was functioning within an area where insects are plentiful," it declared that the blackout screens on the windows were "quite satisfactory."<sup>3</sup> Finally, the report showed, after the truck and trailer had been packed with the equipment recommended "there is adequate space available and still leave room within the truck for two people to work" while



"preparing surgical packs or, with the proposed type of inside sterilizer and heating unit, personnel could actually be sterilizing equipment" while the truck was in transit.<sup>4</sup>

Adverse criticisms of the unit, with one exception, were all of relatively minor importance. Utility of the unit would be improved, it was believed, by providing for the following: (1) heavier catches on cabinet doors; (2) slight modification of gooseneck over sink and of drain pipe underneath; (3) covering for power inlet plug on outside of truck body; (4) luggage straps over cabinets to facilitate packing of supplies; and (5) ladder or hand and toe holds on outside of truck body to make filling of water and airheater gasoline tanks easier.<sup>5</sup> More important, perhaps, were thirty-odd suggestions for changes in or additions to the tentative equipment list.<sup>6</sup>

"The largest defect and one which caused almost constant trouble," however, "was the steam sterilizer."<sup>7</sup> Upon arrival of the truck in Atlanta--and frequently thereafter--small leaks in the tank had to be repaired. "Inasmuch as Colonel Quinzel Director of the Medical Department Equipment Laboratory has informed us that this type combination steam sterilizer and water heater will not be used on future models," the Fourth Auxiliary Surgical Group reported, "it is not believed necessary to go into details as to its defects."<sup>8</sup> Nevertheless it did observe, among many more minor deficiencies, that "Steam is not produced rapidly enough or in sufficient quantity";<sup>9</sup> that "Boiler capacity is inadequate"; that "steam condenses on the inside of the sterilizer with consequent soaking of the surgical packs"; and that maintenance of a head of steam sufficient for sterilization was difficult.<sup>10</sup> It was believed, however, that "The use of a separate steam sterilizing unit apart from the water heating unit, such as is being planned, should solve these difficulties."<sup>11</sup>

The Fourth Auxiliary Surgical Group opined, furthermore, that the "unit as now constructed is not suitable for work in cold climates" because the uninsulated outside water pipes "froze at a temperature of 26° F. while the truck was in use."<sup>12</sup> Although it understood "that later trucks will have inside plumbing," it did suggest that "on the present models these exposed pipes be insulated to afford some protection from the cold."<sup>13</sup> Notwithstanding the sub-freezing weather, on the other hand, "no trouble was experienced from freezing of water or watery solutions inside the truck itself."<sup>14</sup>

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3. Testing by Fifth Auxiliary Surgical Group.

Approximately two weeks after the Fourth Auxiliary Surgical Group had completed its field and operational testing of the surgical operating truck at Atlanta, Georgia, the commanding officer of the Fifth Auxiliary Surgical Group, Fort Sam Houston, Texas, began negotiating with The Surgeon General's Office for use of the truck by his organization, which was shortly to go on bivouac.<sup>15</sup> The Surgeon General's Office approved his proposal thus to use the pilot model<sup>16</sup> and issued appropriate instructions to effect the transfer of the truck.<sup>17</sup> Fully loaded and with trailer attached, the pilot model surgical operating truck was driven from Georgia to Texas and reached Fort Sam Houston on 8 March 1944.<sup>18</sup> There it was "used continuously," until 25 May 1944, "both in the performance of animal surgery and in ASF demonstrations."<sup>19</sup> It was shipped on 26 May 1944 to the Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania.<sup>20</sup>

Since the cabinets inside the truck had worked loose en route from Atlanta to Fort Sam Houston, the report submitted by the Fifth Auxiliary Surgical Group on 25 May 1944 recommended that stronger attachment of the cabinets be provided. The unit itself "functioned well," however, and such defects as were found were "essentially the same as those noted by the Fourth Auxiliary Surgical Group."<sup>21</sup> Save for a few additions and exceptions to the previously rendered report--such as the recommendation that a portable fracture table be added, or that the litter supports be higher, or that a ceiling ventilator with fan be installed in the truck, or that certain modifications be made in the recommended list of equipment--the Fifth concurred with the report of the Fourth Auxiliary Surgical Group.<sup>22</sup> Suggestions contained in the report of the Fifth Auxiliary Surgical Group (see Appendix P) were then appropriately coordinated within The Surgeon General's Office and with the Medical Department Equipment Laboratory.<sup>23</sup>

G. Modifications Subsequent to Field Testing.

Before the Fifth Auxiliary Surgical Group had submitted its reactions to the pilot model, the report of the Fourth Auxiliary Surgical Group, promptly upon its receipt, was appropriately coordinated within The Surgeon General's Office and its recommendations were concurred in. Then, on 25 January 1944, this report was forwarded to the Medical Department Equipment Laboratory with the request that "changes be made to overcome the undesirable features reported" and that "this action be expedited in view of the urgent overseas requisition covering these twelve trucks"<sup>24</sup>--that is, the



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vehicles which the Equipment Laboratory had converted into surgical operating units.

On 5 February 1944 the Director of the Medical Department Equipment Laboratory replied by indorsement that "the necessary changes have been made to overcome the undesired features reported by the Fourth Auxiliary Surgical Group" and that "These changes have been incorporated in specifications and drawings covering the truck, 2 $\frac{1}{2}$ -ton, 6 x 6, surgical, operating."<sup>26</sup> Furthermore, "In view of the anticipated standardization of one type truck for use by the Medical Department," the Director indicated, these drawings and specifications had been so planned as to

utilize the type of chassis and body which will be submitted shortly by this office as the basic truck for all types of mobile units of the Medical Department. As such, the standardization of the truck, 2 $\frac{1}{2}$ -ton, surgical operating, will conform basically to the one truck which the Medical Department is expected to standardize at a later date.<sup>27</sup>

One paragraph of this indorsement, which also served to transmit to The Surgeon General's Office certain drawings and specifications relative to the newly developed unit, contained the recommendation

that the truck, 2 $\frac{1}{2}$ -ton, 6 x 6, surgical, operating, as embodied in the applicable drawings and specifications be considered suitable for use by the Medical Department of the U. S. Army, and as such be adopted as a standard vehicle for the Medical Department.<sup>28</sup>

H. Disposition of Service Test Models.

A brief digression is desirable at this point to relate the disposition of the twelve surgical operating trucks being fabricated at the Medical Department Equipment Laboratory. Already The Surgeon General's Office itself had arranged for the timely delivery of the trailers<sup>29</sup> and other equipment<sup>30</sup> necessary to complete the units. It had also informed the Commanding General, European Theater of Operations, in London, England, that the twelve trucks would be ready for shipment to him on 1 February 1944, had requested that he requisition the trucks, and had asked that his requisition indicate the priority desired.<sup>31</sup> This information was received on 19 January 1944.<sup>32</sup>

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On 31 January 1944 the service test models, "complete with trailers and equipment (less the shortages which were reported to The Surgeon General), were turned over . . . to The Quartermaster, Carlisle Barracks, Pa., for shipment";<sup>33</sup> and on 5 February 1944, in the same indorsement that recommended standardization of the truck, the Director of the Medical Department Equipment Laboratory reported to The Surgeon General that "Twelve (12) service test models of the surgical truck, operating, constructed in this Laboratory during the past two months, were packed in accordance with the latest equipment list and driven overland to Boston, Massachusetts, on 3 February 1944."<sup>34</sup>

Within 7 $\frac{1}{2}$  months after the first step was taken formally to initiate Development Project, F-35, then, the pilot model of the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating had been developed and tested and the desired modifications had been made both in the service test models and in the drawings and specifications that would be used in future procurement; and within four months after The Surgeon General himself had proposed the construction and within two months after Headquarters, Army Service Forces, had approved the proposal, 12 more surgical trucks had been converted by the Medical Department Equipment Laboratory into surgical operating trucks. As recommended by the Medical Department Equipment Laboratory, the newly developed unit was now ready for standardization.

#### IV. Standardization Phase.

Even before the Medical Department Equipment Laboratory formally suggested standardization of the new unit, the Chief of the Field Equipment Development Branch, Surgeon General's Office, had recommended in writing to the Chairman of the Medical Department Technical Committee "that the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical, Operating, be reclassified as a standard article."<sup>35</sup>

Consequently, the Medical Department Technical Subcommittee met on 2 February 1944 and recommended that the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating, "be classified as required type, adopted type, standard article."<sup>36</sup> The report of the Subcommittee presented certain pertinent information as required by AR 850-25 and, further, it

recommended that:

(1) Medical Department be responsible for:



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- (a) Specifications, determination of requirements, provision of funds, and issue of the entire item.
- (b) Procurement of special installed equipment beyond that furnished by Ordnance.
- (2) Ordnance Department be responsible for specifications, purchase and inspection of truck-chassis and body with electrical wiring, hot water heater and tanks, sink and plumbing, and PE-75T 2.5 KW Generator (Signal Corps) mounted on a 1-ton 2-wheel cargo trailer.
- (3) Quartermaster Department is responsible for specifications, purchase, and inspection of tent.
- (4) . . . .
- (5) Basis of issue be:
  - One (1) per two (2) team, General Surgical
  - One (1) per two (2) team, Orthopedic
  - One (1) per two (2) team, Maxillo-facial
  - One (1) per two (2) team, Neuro-surgical
  - One (1) per two (2) team, Thoracic Surgical.

- (6) Monthly replacement will be:

- (a) Zone of interior 0
- (b) Theater of Operations 5.0<sup>37</sup>

This recommended monthly replacement rate, a footnote in the report of the Subcommittee explained, was "based upon experience of the replacement required for Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6 (Cargo)." <sup>38</sup>

The unit cost, "based on latest procurement," the report explained, was

\$5,500.00 for truck, trailer, generator, and

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installed equipment. The instruments and supplies in the Equipment List will cost approximately \$4,500.00 in addition to the above.<sup>39</sup>

The total number required "if recommended basis of issue is approved" was indicated as 159 for 1944 and as 53 for 1945.<sup>40</sup> Finally, for 1944 the "Total cost if recommended basis of issue is approved" was stated as \$874,500.00 less equipment; \$1,590,000.00 including equipment," and for 1945 as \$291,500.00 less equipment; \$530,000.00 including equipment."<sup>41</sup>

Meeting 7 February 1944, the Medical Department Technical Committee recommended

that the recommendations proposed in the Subcommittee report be adopted with the following modifications:

- (1) Medical Department be responsible for:
  - (a) Requirements, funds, storage, and issue of the entire item.
  - (b) Procurement of special installed equipment beyond that furnished by Ordnance.
  - (c) Procurement, storage, and issue of metal base plate for securing generator to the trailer used with the truck.
- (2) Ordnance Department be responsible for:
  - (a) Specifications, purchase, and inspection of truck chassis and body, electrical wiring, hot water heater and tanks, and sink and plumbing.
- (3) Quartermaster Department process for standardization the Tent, Surgical Truck, Operating as modified by the Medical Department.
- (4) The following items be listed on T/E for use with subject item:



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- (a) PE-75T 2.5 K.W. Generator  
(Signal Corps).
- (b) 1-Ton 2-Wheel Cargo Trailer.
- (c) Tent, Surgical Truck, Operating.
- (5) Equipment List for subject truck be  
classified as required type, adopted  
type, standard article.
- (6) Estimate of unit cost be \$4,200.00.<sup>42</sup>

On 8 February 1944 The Surgeon General's Office forwarded to Headquarters, Army Service Forces, copies of (1) the report of the Subcommittee, (2) the approval of the Subcommittee report (with modifications previously noted) by the Medical Department Technical Committee, (3) the signed concurrences by members of the Technical Committee, and (4) a description and photographs of the item. Concurrently, The Surgeon General's Office "requested that the recommendation by the Medical Department Technical Committee for standardization" of the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating "be approved."<sup>43</sup>

Substantially as recommended by the Medical Department Technical Committee and its Subcommittee, the Procurement Assignment Board, Headquarters, Army Service Forces, on 10 February 1944 indicated that

responsibility for procurement of the item  
TRUCK, 2 $\frac{1}{2}$ -TON, 6 x 6, SURGICAL, OPERATING  
less installed surgical fixtures and equip-  
ment is assigned as follows:

Specifications	-	Ordnance
Body specifications subject to technical requirements of Medical Department		
Determination of	=	Medical
Requirements		Department
Provision of Funds	+	Medical
		Department
Purchase	-	Ordnance
Inspection	-	Ordnance

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The Medical Department is responsible for all functions of procurement for installed surgical fixtures and equipment.<sup>44</sup>

Then, on 20 February 1944, Requirements Division, Headquarters, Army Service Forces, also following closely the recommendations of The Surgeon General's Office, classified the unit as required type, adopted type, standard article; charged The Surgeon General with storage and issue of the item; approved the recommendations relative to basis of issue, replacement factors, and equipment; and indicated that "The Quartermaster General is being directed, by separate communication, to process the item, Tent, Surgical, Operating, Truck, for standardization."<sup>45</sup> This indorsement from Headquarters, Army Service Forces, concluded with an expressed desire that The Surgeon General "submit promptly to the Director, Requirements Division, this Headquarters, changes in the Army Supply Program resulting from the above action."<sup>46</sup>

Promptly the Technical Division notified other interested agencies within The Surgeon General's Office--namely, Supply Service and Fiscal, Surgical, and Training divisions--of this favorable action by higher authority<sup>47</sup> and then granted permission to the Medical Department Equipment Laboratory to drop the project from its Monthly Narrative Report.<sup>48</sup> The new surgical operating truck was now considered ready for procurement--ready within less than eight months after formal initiation of Development Project, F-35.

V. Procurement Phase.

Procurement--or at least production--of the surgical operating truck, like that of the surgical truck for the armored medical batalion discussed in Chapter V above, was at first chronologically entwined with development. While the surgical truck was in the developmental phase, one may recall, a letter of intent to purchase 24 production models was proffered as inducement to get the pilot model commercially constructed. While the surgical operating truck, on the other hand, was still being developed, the Equipment Laboratory itself fabricated and sent overseas 12 production models, which had been classified as service test type.

Possibly after standardization of the new unit--but still during the early stages of its procurement--the Army Medical Purchasing Office seems also to have employed the expedient



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of converting, by contract, other Medical Department vehicles (probably standard surgical trucks) into surgical operating trucks; for correspondence from the Purchasing Office mentions the cost of "revamping of old trucks."<sup>49</sup> Unless this theory be accepted, there seems to be no explanation of how there could have been in use or on hand as of 17 April 1944 "About 36" of these units<sup>50</sup> when the original order for 24 of the surgical operating trucks, according to the Army Medical Purchasing Office records, was not placed until 24 June 1944 and when delivery of the first nine units of this original order was made on 10 October 1944 and of the other 15 on 27 October 1944.<sup>51</sup>

However the vehicles may have been procured at first, records of the Army Medical Purchasing Office reveal that by 31 October 1945 a total of 207 had been ordered and delivered.<sup>52</sup> As listed in the Medical Supply Catalog, the unit cost of Stock Number 9959105, Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating was \$4,200, and the unit cost of the medical equipment for the truck (Stock Number 9959110) was \$5,222.95.<sup>53</sup> On the basis of these figures, then, the 207 units cost the Army Medical Department a total of \$1,950,550.65.

## VI. Evaluation.

As with most of the other projects previously discussed, an appraisal of Development Project, F-35 resolves into an analysis of (1) the practicability of the item developed and (2) the success with which the project was administered.

### A. The Item.

Except for the gross inadequacy of the combination sterilizer and hot water system--a deficiency which was rectified even before the first lot of 12 left the Medical Department Equipment Laboratory, those who tested the surgical operating truck in the Zone of the Interior found it generally excellent. (To judge only by pictures of the two, it appears much more field-worthy than a similar German-developed surgical operating trailer captured toward the close of the war.<sup>54</sup>) Although a thorough analysis of overseas reaction has not been attempted, preliminary examination of reports from Europe and the Mediterranean suggests that the amount of favor with which the American-developed units were received was conditioned by the tactical employment of the organization making the report.

The First Auxiliary Surgical Group, for example,

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which operated in the European Communications Zone until 12 April 1945,<sup>55</sup> reported that "As used in this theater, Auxiliary Surgical Groups had no need for mobile Surgical Operating Trucks";<sup>56</sup> and, as a consequence, it had in April 1945 turned back those trucks which had been previously issued to it.<sup>57</sup> On the contrary, the First United States Army, which had been supported during its initial landings on the beaches of Normandy by the Third Auxiliary Surgical Group, officially declared that "The practical value of the [mobile surgical operating] unit in augmenting the operating room facilities of an evacuation hospital is established."<sup>58</sup> Even those who found the truck superfluous, however, had no criticism of its engineering design or construction.

Until a more thorough study of field use can be made, therefore, the historian of Development Project, F-35 believes that the fairest evaluation of the effectiveness of the Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating in theaters of operations is to be found in this summary opinion of the Third Auxiliary Surgical Group:

When casualties are heavy and hospitals few, such as in the early days of a beachhead, mobile [surgical operating] units are excellent. When casualties become predictable and hospitals numerous, they are excess.<sup>59</sup>

B. Administration of the Project.

Though in its procedural aspects this project could have been handled better, few of the developments discussed in this monograph were generally more effectively administered than was Development Project, F-35.

1. Liaison.

Especially noteworthy was the liaison maintained throughout. First, The Quartermaster General was asked to authorize direct communication between his office and the Medical Department Equipment Laboratory to expedite work on the surgical operating tent. Then, the Commanding Officer of the First Auxiliary Surgical Group—one of the units for whom the truck was being designed—was ordered to the Equipment Laboratory on temporary duty during the early developmental stage to make recommendations concerning the surgical operating truck and its equipment. The list of equipment which he submitted itself underwent extensive coordination before it was finally approved. Meantime, close, intelligent, and understanding relations with engineers in industry were



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maintained while a suitable sterilizer was being developed. And finally, as promised by The Surgeon General's Office when Headquarters, Army Service Forces, was asked to approve the project, the Armored Force was adequately consulted with regard to the feasibility of replacing its surgical truck with the proposed surgical operating unit. Liaison activities among the various interested agencies, therefore, left nothing to be desired.

2. Procedures.

Paradoxically, administration of the procedural aspects of Development Project, F-35 was at once both blameworthy and commendable.

(a) Project Initiation.

During formal establishment of the project, one will recall, procedures required by AR 850-25 were not meticulously observed. The request for project initiation, for example, had passed through neither the Subcommittee nor the Medical Department Technical Committee. Even before military characteristics were formally proposed, initiation of the project had been approved by Headquarters, Army Service Forces--though not until some time and considerable effort had been spent in clarifying correspondence between that headquarters and the office of The Surgeon General. Voluntarily The Surgeon General's Office later processed military characteristics in accordance with AR 850-25; but had the proper procedure been observed from the first, even this slight misunderstanding of Headquarters, Army Service Forces, would doubtless have been obviated.

Whether this procedural irregularity resulted from a mere oversight or from a laudable desire to expedite the development, the historian can only speculate. But the frequency with which similar irregularities had occurred and had been corrected in other projects then complete would seem to preclude the possibility that the irregularity in this instance occurred solely from oversight. An analysis of how the dates of this project fit into the broader pattern of World War II leads to the conclusion that the Army Medical Department was, on the contrary, taking every possible short-cut to have surgical operating trucks ready for the invasion of Europe that was to occur the following June. Such an aim--then held so highly secret--is of course not apparent in the correspondence. But if this really were the purpose in short-circuiting the procedure prescribed by AR 850-25, few would challenge the motive of the attempt to

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expedite the project initiation, even though it did fail to result in the desired saving of time.

(b) Classification of Trucks as Service Test Type.

Unlike the action initiating the project, the action to classify the trucks constructed by the Equipment Laboratory as service test type was administered strictly in accordance with the literal requirements of AR 850-25. Considered in its relation to the broad aspects of this project and to the much broader pattern of the world-wide military situation as it then existed, the classification of these trucks as service test models also seems to have been a clever and praise-worthy expedient to get the surgical operating trucks into production so that they might be ready for the invasion of Europe. By classifying the proposed trucks as service test type, funds allotted for research and development only could be used legally for their production; and since final standardization did not wait upon overseas reports as to practicability of the trucks in combat, the historian is led to conclude that it was the desire to get them into production rather than the intention of having them actually service tested that led to classification of the trucks as service test type.

Again, if the motive for classifying the units as service test type be interpreted correctly, those administering Development Project, T-35 should be commended for their ingenuity. To their entire plan only one possible serious objection might be raised--and as to the validity of that the historian probably has no right to judge. But with the fabrication of the 12 surgical operating units being done by the Medical Department Equipment Laboratory, work on other research and development activities at that installation came to a virtual standstill. As one officer assigned to the Equipment Laboratory later remarked,

Here The Surgeon General's Office was using a Development Laboratory as a small scale production factory for the badly needed twelve units for overseas. Needless to say the limited personnel of Medical Department Equipment Laboratory was unable to do much development work when the entire shops and staff were busily engaged in turning out the twelve units.<sup>60</sup>



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(c) Standardization.

In its decision promptly to standardize the surgical operating truck, The Surgeon General's Office acted solely, as planned from the first, upon the basis of tests performed by the Fourth Auxiliary Surgical Group. A possible explanation of the reason it did not wait on performance reports of the service test models overseas has already been suggested: The service test models seem to have been intended only as production models, but under a different name. That it did not await results of the tests of the Fifth Auxiliary Surgical Group may be explained by the fact that these tests had not been anticipated, since they were instigated, one may recall, by the Fifth Auxiliary Surgical Group itself rather than by The Surgeon General's Office. Although experiments conducted during maneuvers--if not during combat--would have been more desirable as a final basis for standardization, the report of tests conducted on the grounds of Lawson General Hospital by the Fourth Auxiliary Surgical Group was thorough and, under the circumstances, quite adequate. And the formal classification of the Truck, 3 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating as a standard article was exemplary of the procedure required by AR 850-25.

All things considered, then, Development Project, F-35 was a model of effective administration.

FOOTNOTES TO CHAPTER X

- <sup>1</sup>Ltr. to The Surgeon, 7th Army, APO 758; U. S. Army, fr. CO, 2nd Auxiliary Surgical Group, 8 Jan. 1945; subject: "Annual Report [1944/];" p. 1; et passim, SECRET (Hist. Div., S.G.O.). Extracted in clear.
- <sup>2</sup>Ibid.
- <sup>3</sup>Ibid.
- <sup>4</sup>T/O & 8-500 (18 Jan. 1945), p. 34.
- <sup>5</sup>See Chapter V, pp. 295-353, supra.
- <sup>6</sup>Elizabeth Henney, "They'll Take Care of Him In a Hurry, If He's Wounded," in the Washington Post (9 Nov. 1943), p. 4-B (A. M. R. & D. Bd.).
- <sup>7</sup>Memo to Chf., Research Coordination Br., fr. Chf., Field Equipment Development Br., 25 Jun. 1943; subject: "Research Project for Revision of Contents and Arrangements in the Present 2 $\frac{1}{2}$ -ton, 6 x 6 Truck, Surgical"; et passim (A. M. R. & D. Bd.).
- <sup>8</sup>Ibid.
- <sup>9</sup>Ltr. to T. Q. M. G., fr. S. G. O., 25 Jun. 1943; subject: "Request for Research Projects be Established" (A. M. R. & D. Bd.).
- <sup>10</sup>Memo. to Chf., Field Equipment Development Br., fr. Chf., Research Coordination Br., 1 Jul. 1943; subject: "Truck, Surgical Operating (A. M. R. & D. Bd.). See also penciled notation on memo. to Chf., Research Coordination Br., fr. Field Equipment Development Br., 25 Jun. 1943 (A. M. R. & D. Bd.).
- <sup>11</sup>Ltr. to T. C. G., A. S. F., fr. Dir., Plans Div., S. G. O., 30 Jun. 1943; subject: "Truck, Surgical, Operating - Development Project on" (A. M. R. & D. Bd.).
- <sup>12</sup>Ibid.
- <sup>13</sup>Ibid.



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- 14 1st Ind. to T. S. G., fr. Hq., A. S. F., 5 Jul, 1943;  
basic: see n. 11, p. 567 (A. M. R. & D. Bd.).
- 15 Ibid.
- 16 2nd Ind. to C. G., A. S. F., fr. Dir., Plans Div., S. G. O.,  
6 Jul. 1943; basic: see n. 11, p. 567; et passim (A. M. R.  
& D. Bd.).
- 17 Ibid.; et passim.
- 18 Ibid.
- 19 Ibid.; et passim.
- 20 Ibid.; et passim.
- 21 Ibid.; et passim.
- 22 Ibid.; et passim.
- 23 3rd Ind. to T. S. G., fr. Dir., Requirements Div., A. S. F.,  
9 Jul. 1943; basic: see n. 11, p. 567 (A. M. R. & D. Bd.).
- 24 Memo. to Chf., Field Equipment Development Br., Plans Div.,  
and Surgical Div., 13 Jul. 1943; subject: "Truck, Surgical,  
Operating - Development Project on" (A. M. R. & D. Bd.).
- 25 Ltr. to Dir., M. D. E. L., fr. Lt. Col. John B. Klopp, 2  
Aug. 1943; subject: "Request for Military Characteristics"  
(A. M. R. & D. Bd.).
- 26 2nd Ind. to T. S. G., fr. Dir., M. D. E. L., 7 Aug. 1943;  
basic: see n. 25, above (A. M. R. & D. Bd.).
- 27 Memo. to Chf., Research Coordination Br., Plans Div., S. G.  
O., fr. Chf., Field Equipment Development Br., Plans Div.,  
13 Aug. 1943; subject: "Military Characteristics re. Truck,  
Surgical, Operating. E-35" (A. M. R. & D. Bd.).
- 28 Rpt. to M. D. T. C., fr. Subcommittee on Field Equipment,  
23 Aug. 1943; subject: "Truck, Surgical, Operating" (A. M.  
R. & D. Bd.).
- 29 Memo. [for record] fr. Secty., M. D. T. C., 6 Sep. 1943,  
subject: "Truck, Surgical, Operating" (A. M. R. & D. Bd.).  
And see also Min. of M. D. T. C., Meeting No. 9, 6 Sep.  
1943, Item No. 71, "Truck, Surgical, Operating," pp. 4-5,  
RESTRICTED (Rec. Rm., S. G. O. 451.2-1). Extracted in  
clear.

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- <sup>30</sup>Ltr. to C. G., A. S. F.; fr. Chf., Operations Service, S. G. O., 13 Sep. 1943; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).
- <sup>31</sup>1st Ind. to C. G., A. G. F., fr. Hq., A. S. F., 22 Sep. 1943; basic: see n. 30, above (A. M. R. & D. Bd.) and 2nd Ind., to C. G., A. S. F., fr. Hq., A. G. F., 4 Oct. 1943; basic: see n. 30, above (A. M. R. & D. Bd.).
- <sup>32</sup>3rd Ind. to T. S. G., fr. Requirements Div., A. S. F., 6 Oct. 1943; basic: see n. 30, above (A. M. R. & D. Bd.).
- <sup>33</sup>Memo to (1) Chf., Field Equipment Development Br., Plans Div., and (2) Dir., Surgical Div., 7 Oct. 1943; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).
- <sup>34</sup>Memo. to Dir., Distribution Div., S. G. O., fr. Chf., Field Equipment Development Br., 15 Jun. 1943; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical" (A. M. R. & D. Bd.).
- <sup>35</sup>Ltr. to M. D. E. L., fr. S. G. O., 15 Jun. 1943; subject: "Tent, Changes in Truck, 2 $\frac{1}{2}$ -ton, Surgical" (M. D. E. L.).
- <sup>36</sup>Ibid.
- <sup>37</sup>Ibid.
- <sup>38</sup>Ibid.
- <sup>39</sup>Memo. to Dir., Distribution Div., S. G. O., fr. Chf., Field Equipment Development Br., 25 Jun. 1943; subject: "Requisition for X-Ray Field Unit, Fluoroscopic; 2 $\frac{1}{2}$ -Ton, 6 x 6 Truck, Surgical" (A. M. R. & D. Bd.).
- <sup>40</sup>Monthly Narrative Report, M. D. E. L., 1-31 Jul. 1943, p. 22 (A. M. R. & D. Bd.).
- <sup>41</sup>Memo. to Dir., Plans Div., fr. Chf., Field Equipment Development Br., 31 Jul. 1943 (A. M. R. & D. Bd.).
- <sup>42</sup>Memo. to Chf., Personnel Service, fr. Plans Div., 31 Jul. 1943 (A. M. R. & D. Bd.).
- <sup>43</sup>Monthly Narrative Report, M. D. E. L., 1-31 Aug. 1943, p. 18 (A. M. R. & D. Bd.).
- <sup>44</sup>Ibid.; et passim.  
The tentative list of equipment, however, did not include



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any that was to be permanently installed. (Ltr. to T. S. G., fr. M. D. E. L., 25 Aug. 1943; subject: "Tentative List of Equipment for Surgical Truck, Operating" - A. M. R. & D. Bd.); and for text of the list, see ibid., Incl. 1.

<sup>45</sup>Ibid.

<sup>46</sup>Ltr. to T. S. G., fr. Capt. G. T. Kellogg, 7 Dec. 1945; subject: "Truck, 2½ ton, Surgical Operating, 6 x 6, Project F 35," Incl. 1, p. 3 (Hist. Div., S. G. O.).

<sup>47</sup>Monthly Narrative Report, M. D. E. L., 1-30 Sep. 1943; p. 19 (A. M. R. & D. Bd.).

<sup>48</sup>Ibid., p. 18.

<sup>49</sup>Ibid., p. 20.

<sup>50</sup>Monthly Narrative Report, M. D. E. L., 1-31 Oct. 1943, p. 19 (A. M. R. & D. Bd.).

<sup>51</sup>Ltr. to Hq. Armored Force, fr. M. D. E. L., 5 Oct. 1943 (M. D. E. L.).

<sup>52</sup>Ibid.

<sup>53</sup>Monthly Narrative Report, M. D. E. L., 1-31 Oct. 1943; p. 20 (A. M. R. & D. Bd.).

<sup>54</sup>See n. 51, above.

<sup>55</sup>"Interview with Col. Gorby, M. C.," 21 Oct. 1943 (A. M. R. & D. Bd.).

<sup>56</sup>Ibid.

<sup>57</sup>Ltr. to S. G. O., fr. M. D. E. L., 7 Oct. 1943; subject: "Experimental Surgical Auxiliary Truck Unit" (M. D. E. L.).

<sup>58</sup>Ibid.; et passim.

<sup>59</sup>See, for example, memo. to Dir., Distribution and Requirements Div., S. G. O., fr. Chf., Field Equipment Development Br., Plans Div., 11 Oct. 1943; subject: "Request for transfer of Trucks, Surgical" (A. M. R. & D. Bd.), and memo. (w/incl.) to Distribution and Requirements Div., S. G. O., fr. Chf., Field Equipment Development Br., 28 Oct. 1943; subject: "Truck, 2½-ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).

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60 Memo. to Chf., Research Coordination Br., Plans Div., fr. Chf., Field Equipment Development Br., Plans Div., 18 Nov. 1943 (A. M. R. & D. Bd.).

61 Monthly Narrative Report, M. D. E. L., 1-30 Nov. 1943, p. 13 (A. M. R. & D. Bd.).

The estimated date of completion was given in this report as 15 January 1943; but 1944 was obviously intended for the year, since the report was submitted for the month of November 1943.

62 Ltr. to C. G., A. S. F., fr. Chf., Operations Service, S. G. O., 26 Nov. 1943; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating" (A. M. R. & D. Bd.).

63 1st Ind. to T. S. G., fr. Hq., A. S. F., 6 Dec. 1943; basic: see n. 62, above (A. M. R. & D. Bd.).

64 Ltr. to T. S. G., fr. Dir., M. D. E. L., 7 Oct. 1943; subject: "Experimental Surgical Auxiliary Truck Unit" (A. M. R. & D. Bd.).

65 Ibid.

66 Ltr. to M. D. E. L., fr. American Sterilizer Co., 23 Oct. 1943; subject: "Sterilizer and Hot Water Tank Equipment for Surgical Operating Trucks" (M. D. E. L.).

67 Ltr. to American Sterilizer Co., fr. M. D. E. L., 27 Oct. 1943 (M. D. E. L.).

68 See n. 66, above.

69 Ibid.

70 Ibid.

71 Ibid.

72 Ibid.

73 Ltr. to M. D. E. L., fr. American Sterilizer Co., 22 Nov. 1943 (M. D. E. L.).

74 Ltr. to American Sterilizer Co., fr. M. D. E. L., 25 Nov. 1943 (M. D. E. L.).

75 Ltr. to American Sterilizer Co., fr. Med. Supply Off., Carlisle Barracks, Pa., 25 Nov. 1943 (M. D. E. L.).



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- <sup>76</sup>Ltr. to M. D. E. L., fr. American Sterilizer Co., 29 Nov. 1943 (M. D. E. L.).
- <sup>77</sup>Monthly Narrative Report, M. D. E. L., 1-30 Nov. 1943, p. 13 (A. M. R. & D. Bd.).
- <sup>78</sup>Ibid.
- <sup>79</sup>Ltr. to T. S. G., fr. Capt. G. T. Kellogg, 7 Dec. 1945; subject: "Truck, 2 $\frac{1}{2}$ -ton, Surgical Operating, 6 x 6, Project F 35," Incl. 1, p. 10 (Hist. Div., S. G. O.).
- <sup>80</sup>Ibid.
- <sup>81</sup>Memo. to Maj. A. B. Christie, M. D. E. L., fr. Capt. G. T. Kellogg, M. D. E. L., Dec. 1943; subject: "Surgical truck Heating Plant" (M. D. E. L.).
- <sup>82</sup>Transcription of telephone conversation between Capt. Kellogg, M. D. E. L., and Mr. Ray Jewell, Chf., Engineering, American Sterilizer Company, 3 Dec. 1943 (M. D. E. L.).
- <sup>83</sup>See n. 79, above.
- <sup>84</sup>Ltr. to T. S. G., fr. M. D. E. L., 25 Aug. 1943; subject: "Tentative List of Equipment for Surgical Truck, Operating" (A. M. R. & D. Bd.); and see p. 541, supra.
- <sup>85</sup>Memo. to Lt. Col. John B. Klopp, fr. Dir., Surgical Div., 2 Oct. 1943; subject: "Attached list of equipment for surgical truck, operating" (A. M. R. & D. Bd.).
- <sup>86</sup>Ltr. to S. G., fr. Capt. G. T. Kellogg, 7 Dec. 1945; subject: "Truck, 2 $\frac{1}{2}$ -ton, Surgical Operating, 6x6, Project F 35," Incl. 1, p. 4 (Hist. Div., S. G. O.).
- <sup>87</sup>See penciled note on 2nd Memo. Ind. to Chf., Research Coordination Br., Plans Div., S. G. O., fr. Chf., Field Equipment Development Br., Plans Div., 21 Oct. 1943; basic: memo. to Chf., Research Coordination Br., Plans Div., fr. Chf., Field Equipment Development Br., Plans Div., 11 Oct. 1943; subject: "Request for Trucks" (A. M. R. & D. Bd.); memo to Dir., M. D. E. L., fr. Lt. Col. John B. Klopp, Asst. [S. G. O.], 1 Dec. 1943; subject: "Truck, Surgical, Operating," with incl. (A. M. R. & D. Bd.); ltr. to T. S. G., fr. Dir., M. D. E. L., 15 Dec. 1943; subject: "Tentative Equipment List, Surgical Truck, Operating" (A. M. R. & D. Bd.).

- 88 Memo. to Chf., Field Equipment Development Br., Plans Div., Operations Service, fr. Capt. Paul H. Langner, Jr., M. C., Asst., Procurement Advisory Br., Professional Service, 22 Jan. 1944 (A. M. R. & D. Bd.).
- 89 Undated memo.; subject: "Truck, 2½-ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).
- 90 Monthly Narrative Report, M. D. E. L.; 1-31 Dec. 1943; p. 14 (A. M. R. & D. Bd.).
- 91 Ibid.
- 92 Ibid.
- 93 Ltr. to T. C. G., Lawson General Hospital, Atlanta, Ga., fr. Chf., Operations Service, S. G. O., 18 Dec. 1943; subject: "Truck, 2½-ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).
- 94 Ltr. to CO, 4th Auxiliary Surgical Group, Lawson General Hospital, Atlanta, Ga., fr. Dir., M. D. E. L., 21 Dec. 1943; subject: "Surgical Truck, Operating" (A. M. R. & D. Bd.).
- 95 Ltr. to T. S. G. (Thru: Plans and Training Officer, Lawson General Hospital, Atlanta, Georgia), fr. Lt. Col. H. A. Kind, Commanding, 4th Auxiliary Surgical Group, 17 Jan. 1944; subject: "Truck, 2½-ton, 6 x 6, Surgical, Operating," Incl. 1; p. 1 (A. M. R. & D. Bd.).
- 96 Ibid.
- 97 Ibid.
- 98 Ibid.
- 99 Ibid., p. 2; et passim.
- 1 Ibid., p. 3.
- 2 Ibid., p. 9.
- 3 Ibid., p. 3.
- 4 Ibid., p. 9; et passim.
- 5 Ibid., passim.
- 6 Ibid., pp. 5 ff.



- <sup>7</sup>Ibid., p. 1.
- <sup>8</sup>Ibid., p. 1.
- <sup>9</sup>Ibid., p. 1.
- <sup>10</sup>Ibid., p. 2; et passim.
- <sup>11</sup>Ibid., p. 2.
- <sup>12</sup>Ibid., p. 4.
- <sup>13</sup>Ibid., p. 4; et passim.
- <sup>14</sup>Ibid., p. 4.
- <sup>15</sup>Ltr. to Lt. Col. Elmer D. Gay, M. C., Commanding, 5th Auxiliary Surgical Group, Ft. Sam Houston, Tex., fr. Training Div., S. G. O., 8 Feb. 1944; ltr to Lt. Col. John B. Klopp, M. C., Field Equipment Development Br., Plans Div., S. G. O.; fr. CO, 5th Auxiliary Surgical Group, Ft. Sam Houston, Tex., 12 Feb. 1944 (A. M. R. & D. Bd.).
- <sup>16</sup>1st Ind., to CO, 5th Auxiliary Surgical Group, Ft. Sam Houston, Tex., fr. Deputy Chf., Operations Service, S. G. O., 19 Feb. 1944; basic: ltr. to Lt. Col. John B. Klopp, Field Equipment Development Br., Plans Div., S. G. O., fr. CO, 5th Auxiliary Surgical Group, Ft. Sam Houston, Tex., 12 Feb. 1944 (A. M. R. & D. Bd.).
- <sup>17</sup>Ltr. to CO, 4th Auxiliary Surgical Group, Lawson General Hospital, Atlanta, Ga., fr. Lt. Col. John B. Klopp, [S. G. O.], 19 Feb. 1944; subject: "Truck, Surgical, Operating" (A. M. R. & D. Bd.).
- <sup>18</sup>"Report on Truck, Surgical Operating, 2½ Ton, 6 x 6," fr. Lt. Col. Dugald S. MacIntyre, Exec. Off., 5th Auxiliary Surgical Group, Ft. Sam Houston, Tex., 25 May 1944, p. 1 (A. M. R. & D. Bd.).
- <sup>19</sup>Ibid., p. 1.
- <sup>20</sup>Ltr. to Lt. Col. John B. Klopp, Field Equipment Development Br., Plans Div., S. G. O., fr. Hq., 5th Auxiliary Surgical Group, Ft. Sam Houston, Tex., 25 May 1944 (A. M. R. & D. Bd.).
- <sup>21</sup>See n. 18, above.
- <sup>22</sup>Ibid., passim.

<sup>23</sup>See memo. routing slip to Lt. Col. B. N. Carter and Major Fink, fr. J. B. Klopp, undated (A. M. R. & D. Bd.); and memo. routing slip to Lt. Col. Klopp, fr. Major Langner, 6-6-44, with penciled note thereon dated 8 Jun. (A. M. R. & D. Bd.).

<sup>24</sup>Ltr. to Dir. M. D. E. L., fr. S. G. O., 25 Jan. 1944; subject: "Truck, 2½-ton, 6 x 6, Surgical, Operating; Support, Litter, Operating" (A. M. R. & D. Bd.).

<sup>25</sup>Ibid.

<sup>26</sup>1st Ind. to T. S. G., fr. Dir. M. D. E. L., 5 Feb. 1944; basic: see n. 24, above (A. M. R. & D. Bd.).

<sup>27</sup>Ibid.

<sup>28</sup>Ibid.

<sup>29</sup>See memo. to Chf., Field Equipment Development Br., Plans Div., fr. Research Coordination Br., 7 Jan. 1944; subject: "Truck, 2½-Ton, 6 x 6, Surgical Operating" (A. M. R. & D. Bd.).

<sup>30</sup>Memo. to Dir., Distribution and Requirements Div., S. G. O., fr. Chf., Field Equipment Development Br., Plans Div., 12 Jan. 1944; subject: "Request for Spare Parts Kits; Pumps and Spare Burners" (A. M. R. & D. Bd.); and see memo. to Colonel Welsh, fr. Chf., Research Coordination Br., 20 Jan. 1944 (A. M. R. & D. Bd.).

<sup>31</sup>Copy of radiogram to C. G., ETO, fr. Field Equipment Development Br., Plans Div., S. G. O., 15 Jan 1944, CONFIDENTIAL (A. M. R. & D. Bd.). Extracted in clear.

<sup>32</sup>See memo. for record cross-referencing CM-In-12395 to NYPOE, War, fr. USSOS, London, 19 Jan. 1944; subject: "Request for trucks" (A. M. R. & D. Bd.).

<sup>33</sup>Monthly Narrative Report, M. D. E. L., 1-31 Jan. 1944, p. 13 (A. M. R. & D. Bd.); and for report of shortages referred to, see ltr. to T. S. G., fr. Asst. Dir. M. D. E. L., 28 Jan. 1944; subject: "List of Equipment for Truck, 2½-ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).

<sup>34</sup>See n. 26, above.

<sup>35</sup>Memo. to Chm., M. D. T. C., fr. Chf., Field Equipment Development Br., Plans Div., 2 Feb. 1944; subject: "Truck



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- 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).
- 36 Medical Department Technical Subcommittee rpt on Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical, Operating, to M. D. T. C., 2 Feb. 1944; p. 2. (A. M. R. & D. Bd.).
- 37 Ibid., p. 3.
- 38 Ibid., p. 3.
- 39 Ibid., p. 4.
- 40 Ibid., p. 5.
- 41 Ibid., p. 5; et passim.
- 42 Min. of M. D. T. C., 7 Feb. 1944, RESTRICTED, p. 4 (Hist. Div., S. G. O.). Extracted in clear.
- 43 Ltr. to C. G., A. S. F., fr. Chf., Operations Service, S. G. O., 8 Feb. 1944; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical, Operating" (A. M. R. & D. Bd.).
- 44 1st Ind. to Dir., Requirements Div., Hq., A. S. F., fr. Acting Chairman, Procurement Assignment Bd., Hq., A. S. F., 10 Feb. 1944; basic: see n. 43, above (A. M. R. & D. Bd.).
- 45 2nd Ind. to T. S. G., fr. Dir., Requirements Div., Hq., A. S. F., 20 Feb. 1944; basic: see n. 43, above (A. M. R. & D. Bd.).
- 46 Ibid.
- 47 Memo. to Chf., Supply Service; Dir., Fiscal Div.; Dir., Technical Div., 22 Feb. 1944; subject: "Truck, 2 $\frac{1}{2}$ -Ton, 6 x 6, Surgical Operating" (A. M. R. & D. Bd.).
- 48 Monthly Narrative Report, M. D. E. L., 1-31 Mar. 1944, p. 14 (A. M. R. & D. Bd.).
- 49 1st Ind. to Lt. Richard E. Yates, S. G. O., fr. Maj. A. Hornbacher, Historian, A. M. P. O., 31 Oct. 1945; basic: ltr. to Maj. Arthur Hornbacher, A. M. P. O., fr. Lt. Richard E. Yates, 22 Oct. 1945 (Hist. Div., S. G. O.).
- 50 Table titled "Estimated Requirements, Trucks," 17 Apr. 1944, SECRET (A. M. R. & D. Bd.). Extracted in clear.
- 51 See n. 49, above.  
For authorized distribution of the surgical operating

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and other Medical Department trucks, see ltr. to C. G., POA; C. G., NATOUSA; C. G., CBI; C. G., South Pacific Base Command; C. G., ETO; and C. G., SWPA, fr. Chf., Supply Service, S. G. O., 26 Oct. 1944; subject: "Medical Department Trucks," CONFIDENTIAL (Rec. Rm., S. G. O. 451.2). Extracted in clear.

The following table shows distribution of the surgical operating truck as authorized to the various theaters:

	<u>By 31 Dec. '44</u>	<u>By 31 Dec. '45</u>
POA	0	0
NATOUSA(MTOUSA)	21	21
CBI	0	0
South Pacific Base Command	0	0
ETO	84	84
SWPA	21	21

<sup>52</sup>See n. 49, p. 576.

<sup>53</sup>Army Service Forces Catalog, MED-3 (1 Mar. 1944).

<sup>54</sup>See memo. to Dir., Surgical Consultants Div., fr. Dir., Technical Div., 21 Jan. 1945; subject: "Captured German Surgical Trailer," w/incls. (A. M. R. & D. Bd.).

<sup>55</sup>Ltr. to T. S. G., fr. CO, 1st Auxiliary Surgical Group, A. P. O. 408, U. S. Army, 9 Jun. 1945; subject: "Period Report, Medical Department Activities," p. 1, SECRET (Hist. Div., S. G. O.). Extracted in clear.

<sup>56</sup>Ibid., p. 5.

<sup>57</sup>Ibid., p. 3.

<sup>58</sup>First United States Army: Report of Operations, 20 October 1943 - 1 August 1944, Book VII, Annex No. 16, p. 99, RESTRICTED (Hist. Div., S. G. O.). Extracted in clear.

<sup>59</sup>Annual Report to The Surgeon General from the Third Auxiliary Surgical Group for the Year 1944, p. 46, RESTRICTED (Hist. Div., S. G. O.). Extracted in clear.

<sup>60</sup>Ltr. to T. S. G., fr. Capt. G. T. Kellogg, 7 Dec. 1945; subject: "Truck, 2½-ton, Surgical Operating, 6 x 6, Project F.35," Incl. 1, p. 35 (Hist. Div., S. G. O.).



CHAPTER XI

COMPARATIVE SUMMARY AND ANALYSIS

This chapter is divided into two sections. The first section contains a general classification of the administrative practices described in preceding portions of this study, and includes an analysis of major administrative trends from 1939 to 1945. In the second section an interpretation of these selected aspects of research and development performance is offered. Certain broad hypotheses are advanced to explain pronounced trends in management practice. For those categories of administrative action which exhibit a less discernible pattern, individual analyses are presented.

I. Trends in Project Administration.

A. Project Initiation.

1. Establishment of a Military Requirement.

Despite a marked increase in research and development facilities during World War II, total overseas demand for new items of medical field equipment was, throughout the war period, consistently greater than anything the Medical Department was equipped to satisfy. From the start, therefore, it was necessary to insure, first, that only the most essential development projects would be undertaken, and second, that of those items scheduled for development the most urgently needed items would be developed first. The evaluation of the military requirement which existed for each proposed new item of equipment, inasmuch as it served as the basis for this entire process of selection, was thus an administrative action of the first importance.

According to the provisions of AR 850-25, the authority to decide whether a proposed development project was or was not militarily necessary rested with the "using arm or service" concerned.<sup>1</sup> To what extent was this procedure adhered to in the establishment of the developments described in this study? Were statements of agencies other than using arms or services accepted as valid evidence of the existence of a military requirement? What trends, if any, are discernible in Medical Department practice in these respects?

In two of the projects with which this study has been concerned (the straight pole litter and the folding pole litter), because of the special nature of the experimental work to be undertaken, no formal establishment of a military

requirement was necessary. Project initiation was desired in these instances simply for the purpose of developing satisfactory substitutes for aluminum, which was in exceedingly short supply, for use in the construction of the standard straight and folding pole litters. Since no new litter items were being proposed--the aim being merely to insure continued production of litters already in use by the Medical Department--the above-mentioned provisions of Army Regulations were not applicable.

In all other projects described in this study, the establishment of a firm military requirement by the appropriate using arm or service would appear to have been a specified prerequisite to project initiation. In only three instances, however, (the amphibian litter stop, the ski litter adapter, and the snow and ice ambulance) does the evidence indicate that compliance with this regulation was approximated.

Establishment of a project to develop an amphibian litter stop was based upon a specific request for such an item, submitted to The Surgeon General by the Director of the Requirements Division, Headquarters, Army Service Forces. The request included a brief statement of the purpose of the proposed attachment and an enumeration of its advantages over present methods of ship-to-shore evacuation. It is not clear from the data whether Army Service Forces was entering this recommendation on its own initiative or in behalf of the Transportation Corps, the appropriate using service in this instance. In any event the request had previously been cleared with the Assistant Chief of Staff, G-4, so there was little doubt that a definite military need existed.

On the basis of a memorandum from Headquarters, Army Ground Forces, which stated that a military requirement then existed for a "mountain litter,"<sup>2</sup> the initiation of two projects--the ski litter adapter and the snow and ice ambulance--was proposed by the Medical Department. While both project requests were subsequently approved by the Medical Department Technical Committee with representatives of Army Ground Forces present and concurring--indicating that this interpretation of Ground Forces needs had been sustained--it is not evident from the record that a clear military requirement had been established in either case.

During the course of the snow and ice ambulance project, a toboggan litter adapter was developed. After construction work had been completed, a description of the new item was sent to Army War College and a reply was later received from that office stating that the toboggan litter adapter was "believed to be an essential item of equipment."<sup>3</sup> In view of the above sequence of events it would



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appear that in this instance an independent development project had been initiated and carried through to conclusion without prior written indication of any kind as to the existence of a definite military requirement for the undertaking.

Whatever may be said of the formal adequacy of the above procedures, it would nevertheless appear that the full intent of AR 850-25 had not been realized in most instances. As will be seen below, although not admissible according to regulations, project requests submitted by agencies other than the using army or service contained on the whole more convincing evidence of the existence of firm military requirements than those submitted by Army Ground Forces.

Of the seven projects not initiated by the using arm or service concerned, two were initially proposed by agencies outside The Surgeon General's Office. Reopening of the terminated Army medical laboratory project was requested by the Ninth Medical Laboratory, stationed at Fort Sam Houston, Texas. This project proposal was an elaborate document containing: (1) a statement of the major functions of the laboratory; (2) an analysis, in the light of these functions, of the inadequacies of the laboratory as presently constituted; (3) a description of a mobile unit improvised by the Tenth Medical Laboratory and a discussion of the test findings on this vehicle; (4) a list of tentative requirements for the proposed development item; and (5) a brief analysis of the various vehicles which might be constructed to meet these requirements. This report was cleared through the Laboratories Branch of the Preventive Medicine Service and the Plans Division, Surgeon General's Office, before final submission to Headquarters, Army Service Forces.

A letter received from the Senior Consultant in Ophthalmology, European Theater of Operations, appears to have supplied the initial impetus which led to the establishment of a project to develop a new mobile optical repair unit. This officer's account of the critical difficulties then existing in this overseas theater as a result, in part, of the complexity of the field optical unit then in use was given careful study by the Chief of the Optical Branch of The Surgeon General's Office. The need for a revision of the existing unit was further confirmed by The Surgeon General upon his return from an inspection trip overseas. After a formal conference had been held to consider the specific modifications to be undertaken, a request for project initiation was sent to the Plans Division for clearance with higher authority.

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Of the five projects remaining, two appear to have been initiated at the request of The Surgeon General: the surgical truck and the surgical operating truck projects. The existence of a military requirement was based in the first instance on a careful study of the medical implications of the rapid expansion of the Armored Force. A detailed analysis of the situation was presented to The Adjutant General in the Medical Department's formal request for project initiation. In the case of the surgical operating truck, overseas need was determined by The Surgeon General after an extended tour of the North African Theater.

The establishment of a military requirement for a medical laboratory trailer project was performed by the Plans and Training Division of The Surgeon General's Office. In its project request to the Adjutant General it was pointed out that a similar project had been initiated in 1933 by The Surgeon General after a careful study of the needs of the Army Medical Laboratory, but, due to a lack of funds, this earlier project had never become active. The proposed reorganization of the present laboratory to include three mobile subsections was explained, and the inadequacy of present vehicular equipment in the light of these proposed changes summarized. Reference was made to the mobile unit currently used by the Pennsylvania State Board of Health as a concrete indication of the feasibility of the proposed project. Increased work load of the medical laboratory as a result of recent changes in tables of organization was cited as a further evidence of the existing military need.

In its second petition to The Surgeon General (the first, made in 1939, had been rejected) requesting establishment of a dental laboratory truck project, the Dental Division of The Surgeon General's Office began by restating the aims of the field dental laboratory service and followed this with a detailed analysis of the then standard portable laboratory, evaluating this item in the light of these objectives. Statistics regarding the volume of overseas prosthetic work was cited as evidence of the current military need for a new laboratory unit. Possible alternatives to the present model were then discussed and the advantages of a self-contained, prime mover type of vehicle pointed out. This project request was studied by the Plans Division, approved, and sent to the Medical Department Technical Committee for formal presentation to Army Service Forces.

Despite the wide variety of methods employed, in only one case was project initiation seriously delayed as a result of failure on the part of those concerned to conform to Army Regulations. A dental operating truck project was



first proposed in May, 1942, by the Dental Division of The Surgeon General's Office. While this request stated that an immediate requisition for three such units had been placed by the Air Corps, major emphasis was placed upon the utility of the proposed unit in the Zone of the Interior. This request was subsequently rejected by higher authority within The Surgeon General's Office on the grounds that the existence of a definite military requirement had not been established.

In July, 1943, the Twelfth Air Force, stationed in North Africa, submitted an out-of-channels request that consideration be given a mobile dental operating truck improvised by that unit as a conversion possibility for standard issue. No action was taken on this proposal by The Surgeon General's Office, and the Twelfth Air Force, after obtaining a special allocation of 24 Ordnance trucks for conversion into dental units for the North African Theater, next sent a petition through channels urging establishment of a dental operating truck project at the Aero Medical Laboratory, Wright Field. This request was approved and an Air Force project established.

At this point the Dental Division of The Surgeon General's Office re-introduced its proposal for the establishment of a Medical Department project to develop a mobile dental operating unit. This petition stated that numerous requests for such a unit had been received from overseas theaters and that a military need for the item in the Zone of the Interior to service small detachments and training areas was now quite evident.

Whether as a result of the Dental Division's arguments or because of the necessity of preventing standardization of a mobile unit whose truck parts would not be interchangeable with Medical Department mobile units (the Air Force model employed a different basic vehicle), The Surgeon General's Office gave its consent to establishment of the proposed project and this action was approved by Headquarters, Army Service Forces. While a dental operating unit was thereupon constructed, tested, standardized, and procured in a remarkably short period of time, because of the long delay in approving this project few units reached overseas theaters before the close of the war.

In concluding this section it may be said that while regularized procedures for ascertaining the existence of a military requirement were followed in only a minority of instances, no unwarranted development projects appear to have been initiated and in only one instance (the dental operating truck) was project establishment seriously delayed. As for the adequacy of the evidence they contained, the project

requests described in the section varied greatly. The most direct evidence of the existence of a definite military requirement was contained in the proposals recommending establishment of the optical repair truck and surgical operating truck projects. In these instances, the petitions were based upon first-hand knowledge of overseas needs.

With the exception of the toboggan litter adapter project, for which no prior statement of military need appears to have been obtained, the least amount of evidence on this point was presented by Army Ground Forces in connection with the establishment of the ski litter adapter and snow and ice ambulance projects. The remaining project requests occupied a broad middle-ground between these two extremes. In general, the inadequacies of existing equipment and the way in which these deficiencies could be remedied by the development of new or improved items were effectively indicated. The urgency of these proposed actions, however, was less convincingly demonstrated.

No clear trends in Medical Department practice are discernible in establishing military requirement. Procedures varied widely throughout the entire period of the war.

## 2. Formulation and Processing of Military Characteristics.

The careful formulation of military characteristics for each new item of development and the prompt processing of this data through prescribed channels was, for several reasons, an important part of the process of project initiation. In the first place, every statement of military characteristics was, at least in part, a reflection on the clarity with which a given set of research objectives had been visualized by the initiating agency. As such it was of definite value to the military authorities responsible for final approval or disapproval of the project request.

Secondly, clearance of military characteristics through a designated technical committee provided an excellent opportunity for early discussion of the project, in specific terms, with representatives of all interested arms and services. Finally, once all procedural steps had been completed and project initiation formally approved, military characteristics, by staking out at least the broad outer limits of the proposed investigation, furnished a necessary minimum of directional control over research and development personnel.

According to Army Regulations, military



characteristics for an intended new item of equipment were to be "formulated by the using arm or service, approved by the commanding general of the force in whose command the military characteristics originated, and coordinated through the technical committee of the force or service charged with the procurement of that class of equipment."<sup>4</sup> To what extent were these provisions complied with in the projects described in this study?

A review of the preceding chapters discloses that in no instance is there evidence that a statement of military characteristics was initially formulated by the using arm or service concerned. Only once, in fact, does it appear that a using agency made any substantial contribution in this respect. In the case of the ski litter adapter, shortly before final standardization proceedings were begun, Headquarters, Army Ground Forces presented to the Medical Department a special list of recommended characteristics for the new item. These suggestions were subsequently condensed and added as a fifth military characteristic, supplementing the original four drawn up by the Medical Department and approved at the time of project initiation. Inasmuch as the ski litter adapter had already been developed, Army Ground Forces' contribution in this instance had been largely academic.

In the one other instance of outside participation in the formulation of military characteristics (the surgical truck project), no changes in original Medical Department listings appear to have been effected. Shortly after this project had been approved, Headquarters of the Armored Forces at Fort Knox, Kentucky, submitted a series of five additional characteristics to be established for the new item. There is no indication from the data, however, that these were ever formally incorporated into the project.

In all other cases, military characteristics appear to have been prepared exclusively by the Medical Department--usually by the Equipment Laboratory at Carlisle Barracks, Pennsylvania; in short, by research and development personnel, themselves.

Turning now to the adequacy of the military characteristics prepared, while minimum standards of completeness and precision would appear to have been attained in all instances, the least satisfactory performances in these respects were in the straight pole litter, the folding pole litter, the medical laboratory trailers, and the surgical truck projects. In the last-named instance at least certain of the difficulties experienced in coordinating structural specifications with the Armored Force would seem to be

traceable to inadequate initial formulation of military characteristics for the pilot model vehicle.

In all other instances a relatively high level of precision and completeness was maintained. In contrast to previous practice, the danger now was over-precision of statement. While in general this opposite extreme was successfully, in one instance the enactment of too rigid military characteristics proved to be a serious detriment to research and development personnel.

In the case of the snow and ice ambulance project, one of the characteristics adopted for the proposed vehicle provided that it was to be "so designed that it can be pulled by a mount, small tractor, or if necessary by human hand."<sup>5</sup> This last specification--that the conveyance should be towable by hand--effectively ruled out of consideration virtually all motorized vehicles. Since Army Ground Forces had presented only a very generalized requirement in this instance, the necessity for this particular narrowing of the project was not evident.

The subsequent history of this case would seem instructive. First, the pilot model snow and ice ambulance, constructed by the Equipment Laboratory according to project specifications, was rejected because of its unsatisfactory field performance. Second, it was stated by the testing agency--the Mountain and Winter Warfare Board, Camp Hale, Colorado--that the military characteristics which had been established for this project were, in effect, unattainable. A conveyance light enough to be towed by hand would lack sufficient durability to be towed by a snow vehicle. Third, it was found by the medical personnel at Camp Hale--and this finding was sustained by the Board--that no military requirement existed for a towed snow and ice ambulance for use in mountain terrain. Fourth, employment of the M29 Cargo Carrier (a standard Ordnance vehicle) was recommended by the Board as fully satisfying existing Ground Force requirements. These conclusions were subsequently concurred in by Army Ground Forces, Army Service Forces, and The Surgeon General's Office, and Development Project, F-29, was thereupon terminated.

Though lack of an adequate preliminary investigation of research alternatives would appear to have been an immediate cause of the above difficulties, the enactment of too restrictive military characteristics had prevented a more complete initial survey from being made.

As for the promptness of preparation of military characteristics, as well as the coordination of this data through the Medical Department Technical Committee, there



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was considerable variation in practice. In one group of projects, military characteristics were prepared and forwarded through channels to higher authority, but were never formally processed through the Technical Committee. In two of these cases (the straight pole litter and the folding pole litter) military characteristics had been promptly prepared and included in the formal proposal for project initiation. In a third instance (the medical laboratory trailer) such a list does not appear to have been prepared until approximately two years after project initiation.

A second group of projects may be distinguished in which, although military characteristics were cleared through the Medical Department Technical Committee as required by regulations, the initial preparation of these characteristics was delayed for periods ranging from one to six months. Five items belong in this category--the toboggan litter adapter, the amphibian litter stop, the optical repair truck, the medical laboratory truck, and the surgical operating truck. In all of these instances military characteristics were formulated too late to serve either as a guide for those responsible for final approval of the projects or as a means of broad directional control over research and development personnel. Construction of a pilot model had been completed in these instances by the time a statement of military characteristics had been approved.

One project (the surgical truck) while it bears some resemblance to those in the above category properly belongs in a separate class. Here, approval of military characteristics was delayed approximately one month, not because of a delay in their preparation but because of over-anxiousness. In an attempt to expedite the project, the list had been submitted directly to The Adjutant General's Office instead of the Technical Committee. The Medical Department was subsequently directed to re-route this information through prescribed channels.

A final category of projects may be mentioned in which military characteristics were not only properly prepared, but were promptly coordinated through the Medical Department Technical Committee before submission to higher authority. Four projects may be included in this class--the ski litter, the snow and ice ambulance, the dental laboratory truck, and the dental operating truck. Except for the fact that military characteristics had not in these instances been originally formulated by the designated using agencies, all other procedural requirements had been strictly observed.

As for administrative trends over the entire period covered by this study, the following summary is offered. No trends are observable with regard to using

agency participation in the preparation of military characteristics. The only substantive contribution made by a using arm appeared in a later project stage, after an initial list of characteristics, formulated by the Medical Department, had already been approved. As for the promptness with which military characteristics were prepared, from a chronological standpoint a moderate retrogression is indicated. For the period, 1940-1941, the ratio of prompt to delayed formulations was three to two; for the period, 1943-1944, (no projects described in this study were initiated in 1942) the ratio was three to five.

Considering the quality of these formulations, prior to 1943, statements of military characteristics were relatively imprecise and incomplete. After that date a uniformly high standard both of precision and completeness was maintained, with only one lapse into the opposite extreme of over-rigidity of statement.

In the forwarding of military characteristics through prescribed channels, an equally positive chronological trend is discernible. From 1940 to 1941, military characteristics were correctly processed through the Medical Department Technical Committee on only two out of five occasions, both of these instances of conformance with regulations occurring in the latter year. During 1943 and 1944, clearance of this data through the Technical Committee was accomplished in every instance.

B. The Conduct of Preliminary Research Investigations.

Prior to the initiation of the development of any item of equipment, a technical service should investigate such work as may have been performed along closely similar lines by other technical services, by other departments of the Government, and by other agencies, with a view to directing effort along the most productive lines and diverting it from lines having little promise. Knowledge of the analogous development work in foreign armies should be sought through the Military Intelligence Division of the War Department General Staff.

To what extent were the above and other related procedures followed in the pre-development phases of the projects with which this study is concerned? What trends, if any, may be observed in Medical Department practice?

In beginning this discussion it should, of course, be pointed out that the need for preliminary research investigation varied greatly from project to project. At one extreme were pioneer experiments, such as the snow and ice ambulance,



the first mobile medical laboratory, and the surgical truck. Here no familiar military precedents existed and consequently the need for exploratory research was great. At the other extreme were such specialized developments as the folding pole litter, the ski litter adapter, and the toboggan litter adapter. In these instances, the precedents were many and controlling, and only a highly restricted area remained for independent investigation.

Most of the projects with which this section deals, however, occupied some broad middle ground between these two extremes. While, for example, the straight aluminum litter of 1935 served as a model for both the straight steel and straight wood litters of World War II, considerable deviation in specifications and design was permitted. Similarly, while adoption of the same basic vehicle as had been used in the development of the surgical truck was mandatory for all succeeding medical truck projects, the design and construction of interior fittings as well as the selection and placement of equipment and supplies offered a considerable opportunity for original research and experimentation.

It will be seen from the foregoing summary that, in spite of wide variations, some degree of preliminary investigatory research was necessary for each of the projects considered. It is with this area of discretion--whether in the individual case it was great or small--that the following discussion is concerned.

#### 1. The Study of Past Experience.

At least seven distinct steps were required for the performance, within the full meaning of Army Regulations, of a thoroughgoing preliminary research investigation. A logical first step in this process was the systematic study of all relevant past experience. Study of this kind had a dual utility. First, it was the surest method of "directing effort along the most productive lines and diverting it from lines having little promise," as stipulated in AR 850-25. Second, knowledge of the historical background in the field of research concerned was essential for those responsible for giving final approval or disapproval of a proposed development project. Inclusion of this material, therefore, in all formal requests for project initiation was routinely desirable.

Though an ample record of past Medical Department practice was available for each of the eleven fields of research with which this study has been concerned, in only five instances was this material included in formal proposals for project initiation or continuance. In the case

of the straight and folding pole litters and the medical laboratory trailer, a separate section of the initiation request was devoted to historical background. These summaries were brief but they appear to have been adequate for the purposes intended. In two other instances (the dental laboratory truck and the optical repair truck), while separately designated historical sections were not included in the formal project proposals, numerous references to past practices in these fields were woven into the body of the report.

In all other cases, no historical data appears to have been included in the initial requests for project establishment. In two of these instances, omission of this material would seem to have delayed approval of the project concerned. In the first request for initiation of a dental operating truck project, no reference was made to the existence of two such units in France during World War I, their satisfactory performance at that time, and the demand for additional vehicles of the same type on the part of dental officers serving with the American Expeditionary Forces. The above project request was subsequently rejected on the ground that overseas need for such a unit had not been demonstrated.

In a second case (the surgical operating truck) failure to include in the formal project request adequate historical data indicating previous practice in handling forward area surgical operations, the inadequacies of such practice, and the further inadequacy of the other standard surgical truck to meet this situation, led to a misunderstanding on the part of higher authority of the basic purpose of the project. Only after extended correspondence was this matter satisfactorily clarified, and establishment of the project formally approved.

From a chronological standpoint, the level of Medical Department performance with respect to this first preliminary step appears to have declined markedly after 1941. Prior to that date, all project initiation proposals contained at least a minimum of relevant historical background material. After that date, such information was included in only two out of eight instances.

This is not to say that Medical Department research and development personnel did not, themselves, have an ample awareness of previous research practice in each of the fields here considered. In the case of the ski litter project, for example, it is clearly indicated in the data dealing with the development phase of this undertaking that Equipment Laboratory officials were fully informed as to the earlier ski litter adapters which had been devised and were



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firmly determined to avoid the errors which had been made in the past in this field. Illustrations of this type could be multiplied. However, in the view of the authors of this monograph, this knowledge of the past was in most instances simply the natural by-product of the individual officer's own first-hand experience, and not the result of documentary study. This opinion is based upon numerous interviews conducted over an eighteen-month period, as well as considerable day-to-day association with research and development personnel for periods ranging from four to six months. It was observed that, generally speaking, familiarity with pre-war documents relating to the projects here considered was, insofar as research and development personnel were concerned, the exception rather than the rule.

2. The Study of Existing Military Equipment.

This step was particularly necessary where the development item was to be adopted to a standard supply article, but it had value in other cases as well. Only after a careful survey of current catalog listings was it certain that an existing item of military equipment, either in its present form or after modification, would not satisfy project requirements as adequately as would a completely new item. Such a study, therefore, was a useful safeguard against either the initiation or continuance of unnecessary development projects.

Inasmuch as seven of the development items discussed in this study had been initially proposed with a specific standard equipment model in mind, no further catalog study was necessary in these instances. The straight and folding pole litters were to be patterned after their aluminum counterparts of the pre-war period, while the standard surgical truck was expressly indicated as the basic model for the five subsequent medical truck projects.

In the three adapter projects, however, an intimate knowledge of related items of standard military equipment was essential. In two of these three cases (the ski litter adapter and the toboggan litter adapter) this necessary information was promptly and systematically obtained. Specifications and drawings of all Quartermaster skis, and toboggans were requested and, upon receipt of this data, selected models were requisitioned for experimental use. Research and development personnel already had, of course, complete knowledge of all standard Medical Department litters.

While in both of these instances, certain

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adaptation difficulties were subsequently encountered, these would not appear in any way attributable to the manner in which this investigatory step had been carried out. These particular problems arose either as a result of later developments which could not have been foreseen, or as a result of special conditions existing at the time preliminary research investigation was conducted.

In the case of the amphibian litter stop—the third of these litter adapter projects—a preliminary investigation of all related military equipment does not appear to have been undertaken. Instead, an attachment was developed which was adaptable only to those vehicles which had been initially secured for experimentation. It was subsequently discovered that two other types of amphibian trucks were being used in the field, and it was thereupon found necessary to postpone standardization action several months while specifications and drawings of all types of amphibians were being obtained and the finished litter stop redesigned to meet these additional requirements.

In three instances (the snow and ice ambulance, the medical laboratory trailer, and the surgical truck) pioneer development work was to be undertaken. Consequently, investigation of all relevant existing equipment was especially necessary. In only the last-named of these projects, however, does a complete survey appear to have been made.

While the possibility of converting Quarter-master sleds or toboggans into an experimental snow and ice ambulance was given considerable study, only one Ordnance vehicle (the T-15 Weasel) appears to have been examined in this connection. The narrowness of scope of this preliminary investigation was, as has been indicated in an earlier section, largely necessitated by the restrictive military characteristics adopted for the project. Inasmuch, however, as it was subsequently discovered that the M29 Cargo Carrier, a standard Ordnance vehicle, adequately satisfied all military requirements, it would appear that excessive restrictions on the scope of research had, in this instance, resulted in the initiation and continuance of an unnecessary development project.

In the case of the medical laboratory trailer, while a complete study of all military vehicles does not appear to have been made, under the circumstances such a study would have been largely academic. As a matter of fact, the Medical Department was aware of the existence of a number of promising alternatives to the vehicle finally selected, but available research funds (\$500) were insufficient to permit the requisition of any of these. Ultimately the first "surplus" trailer that could be located was pre-



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empted and development work begun without further preliminaries. This pilot model trailer was subsequently rejected. Several years later, when the project was reopened, conversion of a standard Ordnance truck was successfully accomplished. This basic vehicle had existed at the time the original trailer laboratory had been developed.

In arriving at a final decision regarding the general specifications of the pilot model surgical truck (a specially designed van body mounted on a standard  $2\frac{1}{2}$ -ton, 6x6, light cargo chassis), the Medical Department may well have been influenced to a large extent by the fact that the First Armored Division had already constructed an experimental mobile surgical unit along roughly similar lines. It is, nevertheless, equally clear from the data that this decision was reached only after a survey of all Ordnance vehicles then in production. The requirements of this particular investigatory step had, therefore, been fully met. The final results obtained in this instance were impressive. The unit subsequently developed was not only highly satisfactory as a surgical truck, but it proved to be an excellent model for a series of five other specialized medical vehicles.

To summarize then, in three cases out of six a thorough study of all relevant standard items of military equipment were made. Each of these projects resulted in the production of a satisfactory end item and no delays, attributable to the neglect of any aspect of this investigatory step, appear to have been encountered.

In the remaining three cases, this preliminary investigation was omitted, either in whole or in part. Of this latter group of projects, only one yielded an acceptable end product. In this one instance, however, a major complication was encountered in a later stage of the undertaking which was directly traceable to an initial failure to perform a more complete survey of existing military models.

Two projects ended in failure, in both instances attributable to the type of vehicle which had been selected for experimentation. In one case it was subsequently discovered that an item of equipment, already in standard use, would fully satisfy all military requirements. In the other it was later found that an existing standard item could be readily adopted to the use intended.

As for trends in administrative performance in this field, none is discernible.

3. Survey of Commercial Items.

A survey of relevant commercial items was another step in the preliminary investigatory process. This step was necessary for two reasons. In the first place, commercial items were as a rule highly adaptable to mass production and thus offered a considerable advantage over new development items for which extensive industrial re-tooling would be required. Because of the extreme importance of this factor, it was a stated policy of the War Department that commercial items should be adopted--and with the fewest modifications practicable--whenever such a procedure would satisfy existing military requirements.<sup>8</sup>

A second value to this particular investigatory step lay in the fact that commercial items, even when found inadaptably to military purposes, often contained some new principle of construction or design which could be incorporated with profit into subsequent military models. The importance of civilian equipment as a source of ideas for research and development personnel was demonstrated in one of the projects discussed below.

In seven of the projects examined in this study, the military items proposed for development appear to have had no civilian counterparts.<sup>9</sup> In these instances, therefore, the investigatory step now under discussion was unnecessary. In the cases of the straight pole litter, the folding pole litter, and the mobile medical laboratory, however, there was a relatively large number of at least roughly analogous commercial items.

Performance in these three instances varied considerably, although in no instance does it appear that either a systematic canvass or sampling of this data was attempted. In the two litter projects, information received by the Medical Department regarding civilian litters or stretchers was, in virtually all instances, unsolicited. It should be noted, however, that in these projects--where hope of obtaining a large production contract automatically stimulated manufacturers or their sales agents to submit samples voluntarily--it was less necessary for research and development personnel to assume the initiative in this respect. Actually, in both these instances, a considerable quantity of circulars, photographs, drawings, and descriptions of commercial stretchers was obtained. In a few instances, physical samples were voluntarily submitted.

In neither of the two major phases of the mobile medical laboratory was it possible for research and development personnel to exercise free choice in the



selection of an experimental vehicle. In the first phase of the project, funds were insufficient to permit purchase of a civilian truck or trailer. By the time the second phase had been initiated, a basic model for all mobile medical units had been established--the newly standardized surgical truck--so, in this instance too, outside purchase of an independently selected vehicle was not possible.

However, research and development personnel still retained considerable freedom of action. Few restrictions existed as to the type of interior construction to be adopted, the particular utilities to be provided, the laboratory supplies and equipment to be included, or the method of storage to be followed. An investigation of all types of commercial laboratory vehicles was therefore indicated.

While the United States Public Health Service, a number of state boards of health, and several field survey units of the Corps of Engineers all possessed mobile medical laboratory units constructed by private manufactures, only two of these--a Coca-Cola trailer used by the Corps of Engineers and a self-contained laboratory truck used by the Pennsylvania State Board of Health--appear to have been studied during either of the two phases of this project. In one of these instances, the data received was unsolicited. Information regarding the Coca-Cola trailer was sent to the Medical Department originally by Army Air Forces. In the case of the Pennsylvania State Board of Health model, the demonstration of this unit at Carlisle Barracks appears to have been made at the request of the Equipment Laboratory.

Although a number of Coca-Cola trailers were subsequently purchased by Army Air Forces, this unit was found to be impracticable for Medical Department use. The Pennsylvania State Board of Health model, on the other hand, was a discovery of the first importance. This unit was apparently the first self-contained, single-vehicle laboratory ever viewed by research and development personnel. It was also, judging from the records, the first mobile unit inspected by the Medical Department in which removable cabinets were used in place of chests for the storage of equipment and supplies. Inasmuch as both of these ideas were subsequently adopted, and inasmuch as no previous reference to either of them was found in the project data, it would appear that they were largely derived from the examination and study of this particular commercial item.

Summarizing this section, it may be said that, on the whole, little attempt was made to conduct a thorough canvass of all analogous items of commercial equipment in any of the three projects to which this procedure was applicable. However, in those instances where the hope of obtaining large

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production contracts supplied an incentive to manufacturers to submit samples of their products voluntarily, the need for such a canvass was proportionately reduced. In the one major instance in which an active attempt appears to have been made to investigate a particular commercial item, the results were impressive. Several basic ideas in subsequent vehicle construction would seem to be traceable to this source.

4. The Study of Related Development Projects.

This investigatory step was of value for several reasons. In the first place, by obtaining at this preliminary stage the latest information regarding all related development items, Medical Department research and development personnel could design a given pilot model so that it would be adaptable not only to related items of equipment currently in use, but also to those items likely to be standardized in the near future. Secondly, the possibility of duplicating research already initiated by another Technical Service could be foreseen and, if desired, avoided. Inasmuch as the responsibility for parallel experimentation of this type would ordinarily rest with the agency which, by this action, created the duplication, it was to the interest of the Medical Department not to undertake such action unknowingly.

Finally, when this preliminary investigation included a study not only of those development projects already in existence, but of those planned for the near future as well, a high order of advance research coordination was sometimes possible. Under certain conditions a development project might then be conducted with a two-fold purpose in view: to produce an item which would not only satisfy the military requirements for that particular project, but which would also be convertible, with a minimum of manufacturing difficulty, into a number of desired related items.

Coming now to the data itself, for two of the projects with which this study is concerned (the straight pole litter and the snow and ice ambulance) no related development projects appear to have been either in progress or in the advanced planning stage. While the records do not indicate that any formal attempt was made by research and development personnel to carry out an investigation in these instances, it is possible that the facts were sufficiently self-evident to make such a survey unnecessary.

In all other instances related development projects were in progress or in the late planning stage. Research and development personnel required no elaborate



investigation, however, to learn of the existence of these projects. All but two were Medical Department undertakings. Of the two outside projects, one was being conducted by the Ordnance Department and involved an item (the amphibian truck) for which the Medical Department had been expressly requested to design a litter stop attachment. The other, an Army Air Forces project (the dental operating truck) had been learned of informally.

In only two instances did possession of this knowledge of related development projects appear to be of no particular advantage to the Medical Department. In the case of the ski litter adapter, although medical research and development personnel were engaged at the same time in the development of a mountain litter, no attempt seems to have been made to design the adapter to fit this new litter item. This appears to have been an oversight. Later, however, in submitting a basis of issue for the ski litter adapter, Army Ground Forces expressly excluded the mountain litter. Last-minute modification of the ski clamp to insure adaptability to this new development item was, therefore, not necessary.

The medical laboratory trailer project also presented a special situation. Here, Medical Department personnel were so impressed with a new development item (the bus-type truck) that they wished to substitute this item for the trailer-type vehicle then being used in the development of a mobile medical laboratory. This request was disapproved by The Adjutant General's Office. As it happened, neither the bus-type truck nor the semi-trailer proved to be a satisfactory field item so no loss or gain was involved.

Except for the above two instances, the Medical Department seems to have uniformly profited from an early awareness of all related development projects. In the case of the amphibian litter stop project which, in point of time, overlapped the standardization phase of the Ordnance Department's amphibian truck project, knowledge of this latter undertaking enabled the Medical Department to take a decisive line of action which was to help materially in the solution of one of its own development problems. As soon as it had become evident that no single litter attachment could be devised which would fit all types of amphibian truck coamings, a uniform coaming design was quickly prepared by the Equipment Laboratory. It was thereupon proposed to the Ordnance Technical Committee that an additional military characteristic, providing for uniform coamings on all amphibians, be included before this item was approved for standardization. This recommendation was adopted, special "modification work orders" were issued to all field installations where amphibians were in use, and, as a result, the range of adaptability of the amphibian litter stop was marked-

ly increased.

In the development of the folding pole litter, detailed first-hand knowledge of another closely related research undertaking--the straight pole litter project--enabled the Medical Department to solve a construction problem which had been holding up development work for months. The basic design of a double-folding litter had, with a few minor exceptions, already been accomplished. No suitable material, however, could be found for construction of the side poles. Every material considered was either too heavy, too light, or on the critical list. The development and subsequent adoption of a laminated wood pole for use in the straight pole litter opened the way to a solution of this folding problem. With this idea, borrowed from a sister project, a successful end item was standardized within a matter of weeks.

The Medical Department's crowning achievement in this respect, however, was attained in the elaborate and technical preliminary planning which attended the development of the surgical truck. Here, with a clear knowledge of the series of additional specialized medical vehicles which were to be developed at a later date, the selection of a standard truck chassis and the design of a special Medical Department van body was carefully undertaken. Body construction, interior fittings, utilities, and numerous other factors were deliberately planned with the view of creating a vehicle which would serve not only as a surgical truck for the Armored Forces, but would also serve as a basic model for a series of five more mobile medical units. The relatively small number of modifications that were found necessary in the succeeding truck projects testifies to the skill with which this initial vehicle had been planned.

One final instance of the importance of this preliminary investigatory step is the case of the dental operating truck. Here, not one but six related development projects were involved. The surgical truck and the dental laboratory truck had already been standardized. The medical laboratory, optical repair, and surgical operating trucks--all built around the same basic vehicle--were in varying stages of completion. At this point it was learned that Army Air Forces had just initiated an independent project to develop a dental operating truck, using an entirely different basic vehicle. The Medical Department acted swiftly to initiate a parallel development project of its own. The parallel experimentation which ensued and which eventually resulted in the adoption of a vehicle developed by the Medical Department, was costly, but it prevented large scale procurement of a vehicle which differed basically from all other mobile medical units. Viewed in this light, the net gain to



the War Department as a whole had been considerable.

In summary it may be said that, while the evidence does not indicate that formal procedures were used in the accomplishment of this fourth investigatory step, under the particular circumstances which obtained such procedures were not necessary. Research and development personnel had a first-hand familiarity with most of the related development projects cited, and in the other instances were able to obtain all needed information informally. However gained, the possession of this knowledge in all but two instances was of marked advantage to the Medical Department. Especially was this true where related development projects in the advanced planning stage were concerned.

#### 5. The Study of Foreign Equipment.

All of the justifications for the preliminary study of American-made equipment, both military and civilian, applied with equal force to the study of foreign models. There was an especially compelling reason, however, for the closest possible study of enemy equipment. In war, the outcome of a competition between belligerents in the field of research and development might often have a direct relationship to victory or defeat on the battlefield. Under these circumstances the quantity and quality of military intelligence reports and the promptness with which these reports were channeled to research and development personnel was of the utmost importance.

To what extent was such information sought by Medical Department research and development personnel in connection with the projects under consideration here? What was obtained? What can be said of the amount and quality of the unsolicited information concerning foreign models which was received by the Medical Department? What trends can be discerned in the carrying out of these procedures?

To begin with, in seven instances (the snow and ice ambulance, the amphibian litter stop, the surgical truck, the medical laboratory truck, the dental operating truck, the optical repair truck, and the surgical operating truck) no information regarding analogous foreign models appears to have been on file either in the research and development sections of The Surgeon General's Office or at the Equipment Laboratory during the course of experimentation.

In two of these instances, some relevant information of this type was received however, after project termination. In the case of the surgical operating truck, which was standardized in February, 1944, photographs of a

captured German model were forwarded to The Surgeon General's Office shortly after VE day. Judging from this data it would appear that, in this particular instance, no crucial loss had resulted from failure to obtain the information earlier. The German unit was mounted on a trailer type vehicle (trailers and semi-trailers had been carefully investigated by the Medical Department in this connection and had been rejected as unsuitable for field use overseas) and was too elaborate in construction to be as effective a forward area unit as the Medical Department model. It is possible, of course, that certain specific features of the German unit might have been incorporated with profit in the Equipment Laboratory design had these photographs been available when the surgical operating truck project was still in progress.

A second instance in which information regarding a pertinent foreign item was not received until after the project concerned had been terminated, was the case of the snow and ice ambulance. During the winter of 1944--just a few months after the formal termination of this unsuccessful project for lack of a suitable experimental vehicle--the Finnish Akja, or snowboat, was extensively tested by the 76th Division on maneuvers held in the vicinity of Camp McCoy, Wisconsin. Aside from certain minor structural weaknesses, which were considered rectifiable, the item was found to be an extremely effective over-the-snow ambulance.

From 15 February 1945 to 8 April 1945, the Finnish Akja was again tested--this time on special cold weather maneuvers conducted by elements of the Canadian Army. In the official Observers Report which was prepared by a mixed military commission upon conclusion of these exercises, it was stated that the Finnish Snowboat or Akja had been tested in comparison with the M29 Cargo Carrier and various other winter evacuation vehicles and had been found to be distinctly the best all-around means of over-the-snow transportation of wounded.<sup>10</sup>

Evidently, the Medical Department would have definitely benefitted had information regarding the above item been obtained at an earlier date. There is no written indication however, that a systematic attempt was made by research and development personnel in the instances to canvass the field of analogous foreign equipment. Inasmuch as adequate description data regarding the Finnish Snowboat would seem to have been readily available, the importance of this particular investigatory step is vividly illustrated.

In five of the projects with which this study is concerned, data regarding analogous foreign models were



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examined by research and development personnel. In most instances the information that was received appears to have been unsolicited. Through the initiative of United States military attaches and certain representatives of the American Red Cross serving abroad, photographs, drawings, technical descriptions, or physical models of the British, Canadian, Czechoslovakian, Swiss, German and Austrian straight pole litters were obtained by the Medical Department. Information concerning a folding pole litter of Swiss make was forwarded to The Surgeon General's Office by the manufacturer's New York sales representative. Through the same channels, two of these litters were subsequently received and tested by the Equipment Laboratory. Finally, prior to initiation of development work on a mobile dental operating unit, a description of two such units developed in England during the early part of 1943 was sent to the Director of the Dental Division of The Surgeon General's Office by a dental officer serving in the European Theater.

In only two instances is it evident from the data that information regarding foreign equipment was directly sought by research and development personnel. On one occasion the Research and Development Division of The Surgeon General's Office requested and received from the Canadian Army Staff in Washington, D. C. photographs of the 3-ton Dental Lorry then being used by the Canadian Army as a dental operating truck.

On a second occasion, at the suggestion of the Director of the Plans Division of The Surgeon General's Office, Dr. Whitman Mead Reynolds, an expert on the medical aspects of winter warfare, prepared and submitted to the Medical Department a comprehensive monograph on the medical problems of mountain troops. This study--which included a detailed discussion of the techniques of over-the-snow evacuation, descriptions of military practices in various parts of the world, and photographs of a wide variety of French, German, Swiss, and Italian litter conversions of winter operations--was of special value for the ski litter adapter and toboggan litter adapter projects.

In summarizing this section, it may be said that in none of the projects here considered do regularized procedures appear to have been established for obtaining relevant technical data concerning analogous foreign equipment items. Quantitatively speaking, in only five out of twelve instances was such data available to research and development personnel during the preliminary phases of research investigation. Most of this data was unsolicited--only two instances having been found where such information was directly suggested by the Medical Department--and

included more references to civilian than to military items. No marked trends in the performance of this investigatory step are discernible. On balance, however, it would appear that more foreign equipment data was received during the early years of the war than during the later period.

6. The Study of Field Improvisations.

Inasmuch as field improvisations were perhaps the most valuable single source of technical ideas available to research and development personnel, the carrying out of this investigatory step was of particular importance. A certain amount of this information was, of course, obtainable automatically--field units sending in reports of their improvisations direct to the Equipment Laboratory or the appropriate research agency within The Surgeon General's Office. The greater part of this data, however, was contained in the quarterly and annual reports submitted by all medical units and medical field installations to the Historical Division of The Surgeon General's Office.

To what extent were field improvisations investigated in the projects now under consideration? What effect, if any, did knowledge of these items have upon subsequent research and development?

To begin with, in no instance do project records show that field unit reports on file in the Historical Division were examined by research and development personnel. Apparently, in all instances only those improvisations were studied which were directly received. In five projects (the straight pole litter, the snow and ice ambulance, the dental laboratory truck, the optical repair truck, and the surgical operating truck) no data of this type appears to have been submitted. In six other projects, however, information regarding pertinent field improvisations was received and was carefully studied by research and development personnel.

In only one instance (the Lippmann ski litter adaptation) did this information prove to be of no value for the project concerned. Here, an improvisation was described which embodied an idea which had already been considered and rejected by the Equipment Laboratory. In all other instances the ideas presented had merit, either in terms of over-all design or the design of a particular component.

The Schwichtenberg litter, designed by a medical officer assigned to the Station Dispensary at Wright Field, was submitted to the Plans and Training Division of The Surgeon General's Office in May, 1939. This model, while ultimately rejected by the Medical Department, nevertheless



introduced certain innovations in folding pole litter design that were destined to be of long-range importance. The present use of a folding rather than a stationary stirrup and the use of a hinge rather than a slipjoint connection for the side poles of the folding litter apparently had their origin in the Swichtenberg improvisation.

In the case of the surgical truck developed by the 47th Medical Battalion of the First Armored Force Division, the contribution was even greater. Constructed over a month before initiation of a similar project by the Medical Department, this truck served to a large extent as a model for the latter undertaking. While the unit ultimately standardized was equipped with a specially designed van body, instead of the standard cargo body employed in the improvised unit, chassis selection and the choice and arrangement of numerous items of equipment would appear to have been heavily influenced by this earlier model.

The value of improvisation as a source of technical ideas was further illustrated on the amphibian litter stop project. Here, experimentation previously conducted at the Amphibian Vehicle Training School under the sponsorship of the Office of Scientific Research and Development proved of considerable value to the Medical Department. While the particular method of fastening litters to the coaming of the amphibian truck which was suggested by this experimentation was not followed, the plan which had been worked out for the placement of litters and their loading sequence was subsequently adapted with only minor modification by medical research and development personnel.

The experimental field laboratory truck, developed by the Tenth Medical Laboratory and tested in the 1943 Louisiana maneuvers, was another item which definitely simplified subsequent problems of research. In this instance the test reports on the performance of this vehicle clearly indicated: (1) that laboratory operations could be satisfactorily performed with a truck; (2) that the use of cabinets for the storage and transportation of equipment was far superior to the use of chests for that purpose; (3) that the standard issue cargo truck, which had been used in the experimentation, was deficient in that it did not have an enclosed body and lacked heating, lighting, and plumbing facilities. It can readily be seen how this information, based upon actual field experience, effectively narrowed the scope of subsequent investigation and helped make possible an early and successful termination of the formal project which was later undertaken in this field.

The last of the instances in which improvisation played an important role was the dental operating

truck project. Here, data regarding a similar unit constructed by the 12th Air Force in North Africa was available to research and development personnel. While the particular vehicle used in this field improvisation was not adopted--by this time the Medical Department surgical truck was the standard model for all specialized mobile units--the comprehensive equipment lists forwarded by the 12th Air Force were of value. With these as a guide, final Medical Department lists were drawn up in considerably less time than had been required in earlier projects.

In summarizing this section, it may therefore be stated that of the six improvisations discussed in this study, five were of genuine benefit in one or more respects. All data regarding field improvisations which were received directly by research and development personnel appear to have been carefully studied and, where indicated, acted upon. Information of this type does not appear to have been actively sought, however. No references were found in any of the project records relating to improvisations described in quarterly or annual reports of medical field units or in other documents. It is unlikely, therefore, that most of the total information available in this field was obtained in the instances cited.

#### 7. The Enlistment of Technical Advisors.

While practice varied according to the field of experimentation involved and according to the technical competence and versatility of research and development personnel, few of the projects with which this study has dealt were conducted without some reliance upon the advice and assistance of outside experts. Therefore, consultation with such experts and, where indicated, arrangement for their active participation in the work to follow, was an essential step in the process of preliminary research investigation.

Broadly speaking, the services of three separate classes of experts were of potential value to the Medical Department in its conduct of medical field equipment projects. First, there were those manufacturers, private or governmental, who were currently engaged in the production of items similar to those proposed for development. Second, there were the research scientists and other subject matter specialists who were regarded as the scholarly authorities in the field concerned. Finally, there were the military experts--professional personnel in the various divisions of The Surgeon General's Office, medical officers assigned to tactical units, officers in charge of specialized training programs--who, through their knowledge of field operations, were best able to advise on the functional requirements of



the new development.

To what extent were these three main sources of technical information successfully exploited in the projects here considered?

In six projects (the medical laboratory trailer, the medical laboratory truck, the dental laboratory truck, the dental operating truck, the optical repair truck, and the surgical operating truck), apart from discussion of miscellaneous items of equipment which was accomplished through routine supply procedures in a later project phase, preliminary consultation with manufactures was not essential. The surgical truck had already been adopted as the basic model for five of these vehicles, while, in the case of the medical laboratory trailer, vehicle choice was frozen to a single item due to lack of funds.

In the remaining seven projects, where preliminary consultation with selected manufacturers was relevant, Medical Department performance varied greatly. In the straight and folding pole litter projects, numerous key supplies of existing military litters were circularized and invited to participate in the development work. To a large extent, the successful end-items that were produced in these two instances were the direct result of this close manufacturer-collaboration. In the case of the surgical truck, early contact was established with Holabird Quartermaster Motor Base, which agency subsequently assisted materially in the preparation of specifications for the pilot model vehicle. Since most vehicle manufacturers were already overburdened with large war orders during this period, contact with commercial manufacturers was, in this instance, delayed not through oversight but through inability to find a company free to handle this small production order.

In two instances, (the ski litter adapter and the snow and ice ambulance) while contact with a private manufacturer was established soon after project initiation, the choice of collaboration--in both instances a carriage maker--would appear to have been less suitable than in the instances cited above. Hardware manufacturers (in the case of the ski clamp) and producers of snow tractors, snow trailers, snowmobiles, and sleighs (in the case of the snow and ice ambulance) were more directly related commercial enterprises, but no written indication was found that these were consulted.

As for results, it is apparent that in both instances manufacturer-suggestions improved the final product. Whether a better ski clamp could have been produced under different auspices is a matter of conjecture, as no

such item was ever comparatively tested with the Equipment Laboratory model. In the case of the snow and ice ambulance, however, relevant data on this point exists. On the basis of comparative field tests conducted at Camp Hale, Colorado, the two trailer models submitted by the Equipment Laboratory were not only found inferior to the M29 Cargo Trailer, as mentioned earlier, but were found inferior to an Allis-Chalmers Snow Trailer as well. In this instance, therefore, the initial choice of manufacturer was demonstrably a crucial factor in the final result.

In two instances, project data does not indicate that any contacts with manufactures were established during the preliminary phases of investigation. In one of these instances (the toboggan litter adapter) successful results were achieved despite the omission, and were accomplished in a very short period of time. In the second instance (the amphibian litter stop) failure to establish early liaison with the General Motors Corporation, manufacturers of the amphibian truck for which the litter attachment was to be designed, led to difficulties during later phases of the project which were to delay final standardization of the item by more than six months.

Turning now to the question of consultation with civilian researchers and subject matter specialists, in only two projects did the Medical Department avail itself of this type of assistance. As mentioned earlier in another connection, in the ski litter adapter and toboggan litter adapter projects, a special monograph containing a large number of photographs of French, German, Italian and Swiss litter adaptations was available for use by research and development personnel. This had been prepared, at the request of the Medical Department, by Dr. Whitman Mead Reynolds, an authority on the medical aspects of winter warfare. While this was evidently valuable data, it is impossible to determine to what extent it facilitated the projects in question.

The early establishment of effective consultative liaison with selected military agencies was a necessary and profitable step in virtually all the projects with which this study has been concerned. While the type of approach adopted varied considerably from project to project, in only two instances (the toboggan litter adapter and the amphibian litter stop) does it appear that this preliminary step was altogether neglected. In the former case no subsequent difficulties appear to have been encountered as a result of this omission. In the case of the amphibian litter stop, however, failure to establish earlier liaison with either the Tank-Automotive Center (Ordnance Department) in Detroit, Michigan, or with the Engineering Amphibian



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Command at Camp Edwards, led to definite complications later on in the project. The pilot model litter stop had subsequently to be twice re-designed to meet the objections of these two agencies.

In two cases (the ski litter adapter and the snow and ice ambulance) advice and suggestions were invited from Army War College; the Mountain Training Center and the Mountain and Winter Warfare Board, both at Camp Hale, Colorado; and the Second Division, in training at Camp McCoy, Wisconsin. The only agency omitted from the above list which would seem to have been an equally qualified source of information was the Alaskan Defense Command. However, while good coverage was obtained, the net results of these efforts would, after study of the correspondence concerned, appear negligible. Insofar as the Mountain and Winter Warfare Board was concerned, it does not appear that this agency was kept abreast of Equipment Laboratory developments in this field. When the completed ski clamps and trailer ambulance were sent to the Board for service testing, it was evident that the Board did not regard either item as a practicable solution of the problem concerned.

In all other instances not only was prompt liaison established with appropriate military experts, but in all cases involving agencies outside The Surgeon General's Office, on-the-spot liaison was substituted for contact via correspondence. The contrast in effectiveness of these two liaison methods (the latter, it will be recalled, had been employed in the case of the ski litter adapter and the snow and ice ambulance) was well illustrated by the results achieved in the six specialized vehicle projects, as will be shown in a later section.

A brief enumeration will suffice to show the wide extent to which coordination with Medical Department and other Army agencies was established as a result of effective performance of this preliminary investigatory step by research and development personnel. Following each project title, the agency or agencies with whom contact was immediately established are given in parenthesis: the surgical (First Armored Division; Headquarters, Armored Forces); the medical laboratory trailer (Army Medical Center; Sanitation Department, Medical Field Service School); the medical laboratory truck (Ninth Medical Laboratory; Laboratories Branch, Preventive Medicine Service, Surgeon General's Office; Sanitation Department, Medical Field Service School); the dental laboratory truck (Dental Division, Surgeon General's Office; dental staff, Carlisle Barracks); the dental operating truck (Dental Division, Surgeon General's Office; Post Dental Surgeon, Carlisle Barracks; Aero Medical Laboratory, Wright Field); the optical repair truck (Specialties and Supply

Planning Division, Surgeon General's Office); the surgical operating truck (First Auxiliary Surgical Group; Fifty-first Evacuation Hospital).

In concluding this section it may be stated that, while minimum use appears to have been made of research scientists and other subject matter experts in the civilian population, in all the major projects described in this study ample contacts were established at the earliest possible date with leading manufacturers in the field and with key War Department agencies. The dispatch and thoroughness with which this preliminary step was accomplished had demonstrably positive results in the later stages of each of the projects concerned.

In the minor projects, these initial steps were seldom followed. While in two instances (the ski litter adapter and the toboggan litter adapter) no subsequent difficulties can be definitely traced to these omissions, in two other cases (the amphibian litter stop and the snow and ice ambulance) a causal relationship between neglect of these procedures and later failures or delays can be definitely established.

No chronological trends are discernible.

C. Development Phase.

1. Manufacturing Relationships.

During World War II, manufacturers, both private and governmental, participated extensively in the development of medical field equipment. Apart from their general availability for consultation regarding specific technical problems, they actively assisted the Medical Department in at least four ways: (1) by presenting descriptive data regarding standard commercial items believed suitable for military use; (2) by voluntarily submitting physical models of this equipment for test by the Equipment Laboratory; (3) by performing special construction work on the basis of specifications prepared by research and development personnel; and (4) by conducting independent experimentation under the general supervision of research and development personnel. In all of these instances, both from a public relations standpoint and from the standpoint of attaining maximum research efficiency, the type of relationship established between the Medical Department and cooperating manufacturers was of the utmost importance.

One particularly complicating problem encountered by the Medical Department in this connection was the



question of monetary inducement. During peacetime, when manufacturing establishments were, in many instances, operating at a point below capacity, the hope of obtaining even a moderate production order was usually sufficient stimulus to lead manufacturers to offer their services to the Medical Department and other governmental agencies. With the outbreak of war, however, plant capacities were soon taxed to the utmost and, particularly in the case of low priority projects, special inducements were necessary to attract the type of manufacturer desired.

How the Medical Department handled these various problems is summarized in the pages that follow.

To begin with, in seven projects (the toboggan litter adapter, the amphibian litter stop, the medical laboratory truck, the optical repair truck, the dental laboratory truck, the dental operating truck, and the surgical operating truck) only minor construction work was necessary and this was performed in the Equipment Laboratory's own workshops at Carlisle Barracks, Pennsylvania. Inasmuch as commercial contracts in these instances were confined for the most part to routine purchase of standard equipment and supplies, no special liaison arrangements were necessary.

In all other projects, however, manufacturing relationships figured prominently in the process of pilot model construction.

Least valuable to the Medical Department were the unsolicited contributions submitted by manufacturers or their sales agents. In the straight and folding pole litter projects, for example, although a large amount of advertising matter describing civilian stretchers was received by the Medical Department, none of this information appears to have been of material value to research and development personnel. Physical models, constructed without previous consultation with the Medical Department, were also, as a general rule, found impracticable. Five such items (two straight pole litters, two folding pole litters, and one ski litter adaptation) were tested by the Equipment Laboratory during the period covered by this report. All of these, including a plywood litter which had been developed by a private manufacturer working in close collaboration with the Conservation Division of the War Production Board, were rejected on the basis of unsatisfactory service test performance. Only one-- a foreign model stated to have been adopted by the Swiss Army-- appears to have had any influence on subsequent Medical Department research. This model not only had the virtue of having been designed primarily for military use, but it appears to have been one of the first packboard litters tested by the Medical Department. A formal development pro-

ject was later instituted to produce an improved litter of this general type.

In four projects, pilot models were constructed by outside manufacturers on the basis of detailed specifications prepared by research and development personnel. The first of these projects (the ski litter adapter) had two construction phases. In the first phase (construction of a light weight ski clamp) no production liaison appears to have been maintained between the Equipment Laboratory and the manufacturer. As a result, although specifications were carefully followed and the finished products were competently built, no suggestions for improvement in design or construction were requested of the manufacturer and none was volunteered from that source. In the second phase (the heavy gauge ski clamp), a close working relationship was established between the Equipment Laboratory and the manufacturer concerned. This was accomplished through correspondence and through periodic inspection trips. In this instance, a number of technical suggestions were offered by the manufacturer, and, in a majority of cases, these were adopted by the Laboratory as superior to original specifications.

A similar interchange of ideas took place during the construction phase of the snow and ice ambulance project. Again, through correspondence and periodic inspection trips effective production liaison was established and maintained. Again, also, numerous changes were made in original specifications as a result of technical suggestions advanced by the manufacturer. Masonite was substituted for a less durable and more critical material initially selected by the Laboratory for use in the construction of the ambulance side walls and floor; steel was substituted for wood in the construction of the axles; runners were reinforced by steel under-plates; and body sides were redesigned to provide for readier collapsibility. Each of the above modifications were adopted by the Laboratory in preference to earlier stipulations. Collaboration had again, therefore--at least in the view of research and development personnel--produced an improved pilot model.

In the case of the medical laboratory trailer, liaison between the Equipment Laboratory and the manufacturer concerned was accomplished through correspondence; in the surgical truck project, because of its extreme urgency, an on-the-spot liaison officer was present throughout the construction period. While the evidence does not indicate that important specification changes were made in either of these cases, production was accomplished with exceptional speed in both instances.

Turning now to those projects in which manu-



facturers assisted the Medical Department by conducting independent experimentation, it will be seen that the liaison factor was of even greater importance than in the above instances. During the development of the straight steel litter, nine different experimental litters were submitted for field test by outside manufacturers. In six of these instances, consultation was held with members of the staff of the Equipment Laboratory before construction work was begun; all but one of the pilot models produced after such consultation made some definite contribution to the research problem at hand. Included in the group was the litter ultimately adopted by the Medical Department.

In three instances, liaison relationships were handled exclusively by research and development personnel in The Surgeon General's Office. These supervisory activities, however, were not coordinated with those then being carried on by the Equipment Laboratory. In none of these instances was a substantive research contribution made. Two of the models were constructed of chrome-molybdenum--a material already rejected by the Laboratory because of its scarcity. The third had been designed according to specifications already discarded by the Equipment Laboratory as impracticable for steel litter construction.

During the development of the straight and folding pole laminated wood litters, close liaison was maintained not only with participating manufacturers but also between research and development officers in The Surgeon General's Office and the Director of the Equipment Laboratory. Thirteen manufacturers' models were submitted in these two projects, and in all instances some important contribution appears to have been made. In no instance was a litter produced according to specifications which had already been definitely rejected.

The importance of the supervisory functions exercised by research and development personnel in the field of litter construction is well established by the foregoing data. Comparing the experimental contributions made by outside manufacturers as against those made by the Equipment Laboratory, however, it is evident that the development activities directly conducted by the latter agency were of only minor importance. Original pilot models were submitted by the Laboratory on only two occasions. None of these models successfully withstood service tests, and, apart from an improved hinge arrangement embodied in four double-folding laminated wood litters designed by the Laboratory, no single feature proved worthy of subsequent adaption. It may be concluded, therefore, that the advances made in the field were, in virtually all instances, the product of joint collaboration

between the Medical Department and private industry--with the manufacturers themselves performing the major part of all physical construction work.

The cost to the Medical Department of work performed by outside manufacturers in connection with the development of medical field equipment was, on the whole, relatively small. Contract arrangements, however, varied considerably according to the nature of the work undertaken. In those instances where detailed specifications were drawn up by the Equipment Laboratory, production charges--including any technical improvements in design or specifications made at the suggestion of the manufacturer--were generally calculated on a cost-plus basis for private concerns and at a cost basis for governmental agencies. In only one instance (the lightweight ski clamp) was an experimental order of this type awarded on the basis of competitive bids. As for the quantities involved on these initial production orders, in only two instances (the medical laboratory trailer and the snow and ice ambulance) was the number of physical models contracted for restricted to the minimum necessary for field testing purposes. In all other instances some inflation of quantity requirement was necessary. In the case of the ski litter adapter, 48 sets of lightweight ski clamps and twelve sets of heavy gauge ski clamps were ordered. In the case of the surgical truck, the initial experimental order called for the production of 24 vehicles.

In the straight and folding pole litter projects, where experimental research as well as routine construction work was involved, the development cost policies adopted by the Medical Department passed through an almost complete cycle. From 1939 until the latter part of 1941, all outside experimental work was undertaken at the manufacturer's own expense, and the pilot models thus produced were accepted by the Equipment Laboratory for field testing only with the understanding that this action involved no cost or obligation whatever on the part of the Government.

During the latter part of 1941 and the whole of 1942, this policy was modified slightly to permit Medical Department requisition of sample poles or litters at a price sufficient to cover costs of material used by the manufacturer. In these instances, development costs seldom exceeded \$10.00 per litter. In 1943, however, Medical Department policies were further liberalized to conform to the latest War Department Procurement Regulations.

Under the new system, the manufacturer credited with successful development of an item was permitted to add development cost to production cost in arriving at a final initial quantity production of the item. Unless this bid was



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substantially higher than competing bids, the contract for the major portion of this initial production was to be awarded to the originating manufacturer. If, on the other hand, this bid was substantially higher than other bids, the production contract was to be awarded elsewhere, and the originating manufacturer fairly paid for his development work as such.

While the motivation of this regulation was clear—to provide a necessary additional inducement to manufacturers to assist in development work and to establish uniform cost policies throughout the War Department—its practical application was difficult.

This was illustrated in the case of the straight and folding pole litter projects. At least six manufacturers had participated in the first project, eight had participated in the second, and nearly all had made some contribution to the problem at hand. In both instances the manufacturer who had produced the specific model accepted by the Medical Department was given final credit for the development. As it happened development credit for both litters went to a single manufacturer.

Upon presentation of final bids for initial production contracts, this manufacturer's bid was decided to be "substantively higher" than competing bids and the initial orders were awarded elsewhere. A bid was then rendered by the originating manufacturer covering total development costs for both projects. This claim amounted to \$34,947.10.<sup>11</sup> While this account was subsequently settled at a considerably lower figure, compared with the sums hitherto spent by the Medical Department for outside research assistance in this field, the new straight and folding pole litters were the most expensive litter developments in Departmental history.

In the early part of 1944, a new system of development cost determination was adopted by the Medical Department. A special type of development contract was instituted whereby approximate costs were arrived at by negotiation conducted with the manufacturer prior to the initiation of independent experimental work. The new policy was designed not only to keep development costs within manageable limits but also, by eliminating the need for inflated production bids to cover these costs, was designed to stimulate competitive bidding on initial production contracts. Inasmuch as the projects with which this study is concerned were all initiated before this recent cost policy was established, no data are available regarding its practical operation.

2. Military Relationships.

During the construction phase of the typical medical field equipment project, two types of military liaison were of potential value. The first was the establishment of a close working relationship between research and development personnel and those Medical Department agencies whose special fields of operation were directly related to the experimental work in progress. In general, this type of coordination tended to insure that the proposed new item would be designed in accordance with the best standards of professional practice in the field concerned. A second type of military liaison which was of particular value during the development stage was coordination with representatives of the using arm or service. This administrative step, which was essentially a means of obtaining the advice and assistance of field personnel, provided additional assurance that the item ultimately developed would be not only functionally sound but also fully adapted to the anticipated conditions of field usage.

To what extent were these military liaison arrangements employed by the Medical Department in the project now under consideration?

Considering first the establishment of liaison contacts with representatives of the using arms and services, in two instances (the straight and folding pole litter projects) action of this type was not practicable. In the first place, in both of these projects construction work was carried on continuously for a period of more than two years. Secondly, these development activities were for the most part being conducted in manufacturing plants located in various parts of the country. Under these circumstances, therefore, liaison with Army Ground Forces and Army Air Forces could not be effectively established.

In all other cases a considerable measure of coordination with using agencies was feasible. However, in seven out of eleven projects the Medical Department failed to take full advantage of this opportunity. In these instances neither were liaison observers from field units present during the construction stage nor was coordination of these activities with the designated using agencies effected through correspondence.

In four of the seven instances in which this procedural step was omitted (the toboggan litter adapter, the medical laboratory trailer, the dental laboratory truck, and the optical repair truck) no subsequent difficulties were encountered which could be attributed to this omission. In



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the remaining three projects, however, this lack of coordination would appear to have had certain detrimental effects.

In the ski litter adapter and snow and ice ambulance projects failure to establish a working liaison with the Mountain and Winter Warfare Board at Camp Hale, Colorado, or the Experimental Board of the Alaskan Defense Command led to the production of items which were unacceptable to these agencies. It is possible, in the case of the snow and ice ambulance, that this item might never have been constructed had a representative for the Camp Hale Board been present at Carlisle Barracks during this period. The board stated, after field tests had been completed, that Ground Force requirements for an over-the-snow evacuation vehicle could be adequately satisfied by the use of existing standard equipment. As for the ski adapters, both the lightweight and the heavy gauge ski clamps designed by the Equipment Laboratory were unfavorably reported upon by these Ground Force testing agencies. Although the latter model was ultimately standardized, this action was accomplished over the objection of the Mountain and Winter Warfare Board.

In the amphibian litter stop project, failure to establish direct liaison with the Engineering Amphibian Command at Fort Edwards, Massachusetts, until after a pilot model had been designed and constructed resulted in a considerable prolongation of the undertaking. Upon receipt of this item for service testing, it was discovered by members of the Engineering Amphibian Command that the litter stop attachment had been designed to fit but one of the three types of amphibian truck coamings which were then in field use. A redesign of the pilot model was thereupon necessary--an operation which consumed approximately six months.

Of the four projects in which close coordination with using agencies was effected during the construction period, substantial benefits would appear to have been realized in every instance. In the surgical truck project, by means of correspondence, conferences, and periodic inspection trips, a close working liaison was developed between the Equipment Laboratory and the Armored Force at Fort Knox, Kentucky. While, because of the absence of an on-the-spot liaison officer, some delays were experienced, the arrangement adopted nevertheless resulted in an extremely practical synthesis of technical ideas. As shown in an earlier chapter, Armored Force contributions to the joint undertaking were many.

In the three remaining projects in this category, (the medical laboratory truck, the dental operating truck, and the surgical operating truck) coordination

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activities were considerably expedited by the temporary assignment of Ground Force representatives to the Equipment Laboratory, for periods ranging from several days to two weeks. Correspondence, in those cases, was held to a minimum and vehicle conversion was accomplished in an unusually short space of time. The specific technical contributions made by liaison officers representing the Ninth Medical Laboratory, the Aero Medical Laboratory, and the First Auxiliary Surgical Group, respectively, have been dealt with in preceding chapters of this monograph. Suffice it to say here that, as in the case of the surgical truck project, these collaborative efforts yielded impressive results.

Turning now to the question of the coordination of construction activities with all Medical Department agencies whose fields of operation were closely related to the experimental work in progress, a somewhat different pattern is presented. For six of the projects described in this study, no such liaison was required. Though several divisions in The Surgeon General's Office were interested in evacuation problems, coordinating the six litter projects with these agencies would have served no useful purpose. The straight and folding pole litters had been standard items of equipment since 1935, and no medical or technological developments were known to have occurred since that time which would necessitate any major changes in design. As mentioned earlier, the purpose of these two projects was merely to develop a suitable substitute for aluminum. As for the other litter projects, they were concerned exclusively with the mechanical problem of adopting the standard litter to various types of Army conveyances, so again no clearance with medical specialists was indicated.

Typically, in the specialized medical truck projects, close liaison with interested divisions in The Surgeon General's Office, Army Medical Center, or the Medical Field Service School was necessary. This collaboration was needed mainly for the preparation of equipment lists for the mobile unit concerned. Seldom did these divisions attempt to participate directly in construction activities. In these instances the procurement of supplies and equipment for the pilot model, once a final decision as to the items to be included had been made by the indicated professional division, was carried out either by the Equipment Laboratory or by the research and development division of The Surgeon General's Office.

The surgical truck project was an apparent exception to this general administrative pattern. Here, inasmuch as the proposed vehicle was to be used merely to provide emergency medical treatment in the forward areas, no



elaborate equipment lists and no special requisitioning procedures were required. Consequently, in this instance, clearance with the appropriate professional division of The Surgeon General's Office was not accomplished.

In all other Medical Department vehicle projects, the selection and procurement of a relatively large amount of special equipment was essential. Administrative coordination in these instances was, on the whole, excellent. In all but one of these projects responsibility for initial preparation of equipment lists was expressly delegated to the appropriate professional division and this specific delegation of function was effectively enforced by periodic follow-up action on the part of the research coordinating agency in The Surgeon General's Office. The results obtained by the use of these procedures were uniformly satisfactory. Equipment lists were promptly compiled, subsequent changes were few, and the construction activities dependent upon these decisions were accomplished with a minimum of delay.

The single exception to this generally high level of administrative performance was the case of the medical laboratory trailer--the earliest of the specialized vehicle projects. In this instance no initial allocation of duties appears to have been made by the research coordination agency in charge of the project and no continuing controls established over the actions of the professional division designated to collaborate in the undertaking. This decentralized administrative arrangement continued in force for a period of nineteen months. By the end of that period, construction activities had come to a complete standstill, equipment lists were still being materially revised, and such equipment as had previously been purchased was, for the most part, in the process of being replaced. Order was restored only when, at the insistence of the Equipment Laboratory, further equipment revisions were banned, immediate preparation of final requisition forms demanded, and a terminal date set for completion of all construction activities.

Considering now the last step in this process--the requisitioning of supplies and equipment selected for inclusion in these specialized medical vehicles--in only one project (the medical laboratory trailer) was this procurement responsibility delegated exclusively to the Equipment Laboratory. The results achieved in this instance were such as to discourage further use of this method in the projects that followed. The Equipment Laboratory, handicapped by its lower-echelon status as a Class IV installation and lacking purchase priorities, found itself unable to exercise its procurement function effectively. While every effort was made to expedite equipment deliveries, it was seven months before a sufficient quantity of these items had been received

to permit shipment of the pilot model for service testing.

In all succeeding vehicle projects, more centralized procedures were followed. Typically, the Equipment Laboratory's procurement activities were limited in these instances to the purchase of standard and readily available items of supply, while non-standard or scarce equipment was obtained through direct procurement action by The Surgeon General's Office. In only one instance (the optical repair truck) was the Equipment Laboratory obliged to procure key supply items, and on this occasion its procurement position was adequately strengthened by the assignment of special priorities.

As for the results obtained under these new requisitioning procedures, the least satisfactory were those achieved in the dental laboratory truck project--the project in which the changeover from the old system to the new was first effected. Here, partly because of a failure to obtain necessary priorities and partly because of inadequate follow-up action by the central research authority on orders already placed, delays amounting in some instances to as much as nine months were encountered. These omissions were not, however, repeated in the four succeeding projects, (the medical laboratory truck, the dental operating truck, the optical repair truck, and the surgical operating truck), with the result that no serious delays in equipment deliveries were encountered in any of these instances.

In reviewing this section, several rather pronounced administrative trends are discernible. In the first place, while liaison contacts with representatives of using agencies were not established in any of the minor projects and were established in only two of the three vehicle projects initiated during 1940 and 1941, close working relationships with on-the-spot liaison officers were maintained in four out of the five vehicle projects initiated after 1942.

As for equipment selection, difficulties were encountered only during 1940 and the early part of 1941. In the five projects initiated after that period, the preparation of equipment lists was well coordinated and promptly executed in every instance. Serious procurement delays occurred only in the two projects established prior to 1942. In all succeeding projects, improved requisitioning procedures resulted in a uniformly high level of procurement performance.

### 3. Engineering and Service Tests.

According to AR 850-25, prior to standardization all newly developed items of equipment should normally



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be subjected to two types of tests. These are listed and defined in this regulation as follows:

a. Engineering tests. - Engineering test will comprise those examinations, investigations, or other observations necessary to the acquisition of scientifically acceptable data of an engineering character which will provide an adequate basis for the determination of the engineering satisfactoriness of the materiel undergoing test. The tests will be conducted by the Army Air Forces or the respective technical services concerned.

b. Service tests. - Service tests are tests of development types of equipment conducted by the using arms and services under the supervision of the commanding general of the forces concerned . . . to determine the suitability of the equipment for service use. Service tests will usually be performed by the using arms or services under the supervision of the commanding general of the forces concerned . . . in accordance with a program of tests prepared under the direction of the commanding general of the force concerned.<sup>12</sup>

Responsibility for the conduct of engineering tests of new items of medical field equipment rested primarily with the Medical Department Equipment Laboratory at Carlisle Barracks. However, for reasons which will be suggested in the final section of this chapter, the Laboratory was unable to give adequate attention to these matters and, as a result, testing and reporting procedures were on the whole handled cursorily or omitted altogether.

In the straight and folding pole litter projects, for example, although a total of 33 experimental models were submitted for examination only four appear to have been subjected to standard engineering tests. In none of these instances were the tests performed by the Equipment Laboratory. Two were conducted by the private manufacturers submitting these litters, while two were performed by the Static Test Branch of the Aero Medical Laboratory at Wright Field. All were static load tests and, in each instance, copies of the final statistical reports were promptly made available to the Medical Department.

In the case of the snow and ice ambulances, the ski litter adapter, the toboggan litter adapter, and the amphibian litter stop, there is no written indication that engineering tests were performed either by the Equipment

Laboratory or by an outside agency.

A better record was achieved in the specialized vehicle projects. Two extensive road tests of the medical laboratory trailer were made, during which detailed observations of the mechanical functioning of the unit were carefully recorded on time charts. On the day following completion of these tests, a complete statistical and analytical report was forwarded by the Equipment Laboratory to The Surgeon General's Office.

While this was the only instance found in which an in-transit report on vehicle operation was prepared, on one occasion (the surgical operating truck) an inspection report was rendered on the condition of vehicle and contents after termination of a road trip. In all of the vehicle projects, however, it is evident from the data that engineering road tests were performed. The surgical truck was driven from Carlisle Barracks to Fort Knox, Kentucky; the dental operating truck, the dental laboratory truck, and the optical repair truck were driven to Washington, D. C., where they were closely inspected by representatives of The Surgeon General's Office; and the surgical operating truck was driven to Lawson General Hospital in Atlanta, Georgia and from there to Fort Sam Houston, Texas. The care with which these tests were conducted, the type and scope of observations made, and the evaluations arrived at, are not known. Except as already noted, no written reports of these operations appear to have been prepared.

Turning now to the question of service testing, in only one instance (the toboggan litter adapter) does this activity appear to have been omitted entirely. In eight out of thirteen instances, moreover, field tests were conducted, as prescribed in regulations, by the appropriate using agency.

The quality of these tests and of the formal reports which followed was, with one exception, uniformly high. Only in the case of the heavy gauge ski clamp--where, through oversight, tests had been conducted with non-standard equipment--was any deficiency of consequence apparent. In all other instances, service testing was performed competently and thoroughly by the using agency, and test findings were reported in detailed and quantitative fashion.

As for the promptness with which testing and reporting procedures were accomplished by the designated using arms and services, the record was less favorable. In only two instances (the amphibian litter stop and the surgical truck) was a final report of test findings received by the Medical Department as early as the month following submission



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of the initial test request. In two projects (the medical laboratory trailer and the medical laboratory truck) this time lapse amounted to 80 and 90 days, respectively; in four instances (the lightweight ski clamp, the heavy gauge ski clamp, the snow and ice ambulance, and the dental laboratory truck) approximately six months were required for the accomplishment of these activities.

This relatively wide variation in the amount of time required to complete essentially similar operations may be attributed, in part, to the differing methods by which service testing functions were administered at the various testing stations concerned. In the two instances in which testing and reporting procedures were most expeditiously handled, the experimental items in question were tested individually as soon as received. Since, under these conditions, a highly intensive type of test was possible, field trials were completed within seven to fourteen days. Moreover, because only one test item was involved in each case, but one to two days were required for the preparation of a final report of test findings.

In the remaining six instances, however, a different procedure was followed by the testing agencies concerned. Here, instead of testing each item as received, testing activities were scheduled to coincide with maneuver periods, at which time all experimental items on hand were subjected to test. From the standpoint of the Medical Department, the disadvantages of this system of testing, as it operated in World War II, were several.

In the first place, unless a given experimental item was submitted to the designated testing station immediately prior to the start of a maneuver period, there was certain to be some delay before testing activities began. This problem was encountered in the case of the lightweight ski litter adaptors, which were shipped to the Experimental Board of the Alaskan Defense Command on 23 November 1943. Since the next mountain maneuvers were not scheduled to start until 1 February 1944, a delay of more than two months occurred before field trials of this item were initiated.

In the second place, the time required for the conduct of full field maneuvers was considerably greater than the time necessary for the satisfactory testing of an individual item of equipment. As previously mentioned, individual service tests of the amphibian litter stop and the surgical truck were completed within a period of seven to fourteen days. The six items tested during maneuvers, however, were not returned from test until after the maneuver in question had been completed. The loss of time that this involved was considerable inasmuch as two of these maneuvers lasted thirty

days each, one lasted forty-two days, two lasted 60 days each, and one lasted 90 days.

The third disadvantage of the maneuver type of service test was the difficulty of preparing promptly final test reports on a number of different experimental items. This point is illustrated in the instances now under discussion by the relatively wide variation in time required for the preparation of written reports of test findings. In two instances this task was completed within three days after the termination of maneuvers; in three instances 14 to 17 days were required; and in one instance 45 days elapsed before the final test report was completed.

The degree of promptness with which testing and reporting procedures were accomplished by designated using arms or services was not, of course, exclusively dependent upon the type of testing system employed. The speed and efficiency with which purely administrative tasks were performed was an almost equally important factor. Serious delays could be, and often were encountered in the processing of initial test requests and test instructions and in the forwarding of final test reports through prescribed channels.

In three instances (the amphibian litter stop, the lightweight ski clamp, and the medical laboratory trailer), only a few days were required for the accomplishment of these operations. In each of these projects, however, direct communication had been established between the Medical Department Equipment Laboratory and the particular testing station concerned. In the amphibian litter stop project, written permission for this direct liaison appears to have been sought and obtained from higher authority. In the remaining two instances, out-of-channels correspondence appears to have been instituted informally.

In five projects, correspondence was, for the most part, carried on through formal military channels. In these instances a number of delays were encountered--attributable mainly to slow processing action by the using arm or service concerned--and, as a result, a considerable amount of time was consumed in the performance of the administration task incident to actual testing and reporting. In the surgical truck project a total of 30 days was expended in clearing the initial test request and test instructions with designated Army Ground Force agencies and in the forwarding of the final report through channels to the Medical Department. In the heavy gauge ski clamp and medical laboratory truck projects, 60 and 70 days, respectively, were required for the completion of these tasks, while in the snow and ice ambulance and dental laboratory projects 90 and 96 days, respectively, were expended.



Considering finally those projects in which testing and reporting procedures were accomplished, not by the using arm or service concerned, but by the Medical Department itself, an entirely different performance pattern is presented. In these instances virtually no time was lost in processing activities, testing periods were uniformly short and intensive, and final reports of test findings were ordinarily completed within a few days after conclusion of field trials.

Here, however, the quality of the test conducted and of the formal reports submitted varied widely. In the straight and folding pole litter projects, service testing and reporting activities were conducted at a high level of efficiency and thoroughness throughout 1941 and during the early part of 1942. After this latter date, however, a marked decline occurred. Detailed test instructions were seldom prepared, field tests were as a rule summarily performed, and final test reports were brief and extremely general in nature.

As for the three remaining projects in this category (the dental operating truck, the optical repair truck, and the surgical operating truck) the service tests which were performed by the Medical Department, while inadequate in some respects, were on the whole of a higher quality than the post-1942 straight and folding pole litter tests. These testing activities involved little actual field usage or cross-country movement; but within camp confines, the vehicles were subjected to regular professional use for periods ranging from four to fourteen days and interior truck facilities carefully evaluated for operational efficiency. With one exception (the dental operating truck report) final test reports were detailed and comprehensive, comparing favorably with those prepared in other projects by designated using agencies.

#### D. Project Termination.

##### 1. Standardization Procedures.

The procedures to be followed in handling requests for standardization of newly developed items of military equipment were clearly outlined in Army Regulations. Such requests were to be cleared first through the technical committee of the technical service responsible for development of the item concerned, approved by the chief of that technical service, and then submitted for final approval to the Commanding General, Army Service Forces, or, for items standardized prior to 10 March 1943, the Commanding General, Services of Supply.

The need for prompt and efficient processing of standardization requests was especially emphasized in AR 850-25:

The importance of avoiding delay in the process of standardization of items of equipment should be realized by all concerned. The classification of an item as standard enables the basis of issue to be determined and procurement planning for necessary production to be inaugurated.<sup>13</sup>

To what extent were these prescribed procedures adhered to in the projects now under discussion? With what degree of speed and thoroughness was such processing executed?

Of the 14 development items described in this study, 12 were subsequently adopted as standard by the Medical Department. In nine of these twelve instances, standardization was accomplished in strict accordance with the provisions of AR 850-25. As soon as prepared by research and development personnel, standardization data was forwarded for preliminary action to the Medical Department Technical Subcommittee. The recommendations of the Subcommittee were reviewed by the parent body, the Medical Department Technical Committee, and were then submitted to The Surgeon General. After approval by The Surgeon General, standardization data were next sent to Headquarters, Army Service Forces. As soon as notification was received that the standardization request had been approved by this authority, appropriate action was taken to enter the new item in the Medical Supply Catalog. Typically, procurement action was also initiated at this time, although in two instances (the surgical truck and the surgical operating truck) in order to meet emergency requirements, production started prior to completion of formal standardization.

The time required for processing this data through all prescribed channels ranged from two to five weeks, but a year-by-year analysis discloses greater speed of performance in 1944 than in the preceding years. During 1942 and 1943, the average time expended in the clearance of a single standardization request was approximately 32 days. In 1944, through a shift in the meeting schedule of the Medical Department Technical Committee from a monthly to a bi-weekly basis, processing time per item was reduced to an average of slightly more than 20 days. Clearance of standardization data through Headquarters, Army Service Forces, accounted for approximately two-thirds of the total time expended.

Standardization procedures were executed smoothly and efficiently in all but three instances. In the ski litter adapter project, because of difficulty in obtaining



adequate requirements data from Army Ground Forces, standardization was completed without this information. Little was accomplished by this action, however, as procurement could not be initiated until the quantity of adapters described had been decided upon. Thirteen weeks elapsed before these data were finally secured. In the amphibian litter stop project, in which standardization action was required both by the Medical Department Technical Committee and the Ordnance Department Technical Committee, clearance through the latter agency was delayed as a result of criticism advanced by the Tank-Automotive Center in Detroit. As mentioned in a previous chapter, the procedural difficulty in this instance was a symptom rather than a cause. Incomplete liaison between the Medical Department and the Tank-Automotive Center during the earlier stages of the project had opened the way for this procedural impasse which was not resolved for several months. The last instance in which difficulty was encountered during the standardization stage was the dental operating truck project. Here, processing action was accomplished in record time but with some sacrifice in factual accuracy. Errors in cost computations and in the description of the basis of issue for the new item necessitated re-processing several weeks later.

In all other projects, standardization data were complete in every respect, no significant procedural delays occurred, and procurement action was initiated immediately upon completion of these activities.

As for the substantive contributions of each of the various agencies participating in the standardization process, the Field Equipment Branch of the Plans Division of The Surgeon General's Office (after February, 1944, the Development Branch of the Technical Division performed these duties) had the responsibility for the initial collection and assembly of all necessary technical data. In meetings of the Subcommittee of the Medical Technical Committee, clearance of standardization data with all interested services and divisions of The Surgeon General's Office was effected. Subcommittee recommendations were closely reviewed (modifications were made in five of the nine projects) by the Technical Committee which also provided coordination with all interested arms and services. Only in the case of Headquarters, Army Service Forces, does processing action appear to have been largely a procedural formality. No instance was found in which Medical Department recommendations were either rejected or amended by this office. All errors or omissions in standardization data appear to have been discovered and rectified solely on the initiative of Medical Department agencies.

Turning now to those instances in which prescribed standardization procedures appear to have been omitted altogether, in only three projects out of twelve did this occur. In the case of the straight steel litter, the straight wood litter, and the folding wood litter, no evidence was found which would indicate that these items were processed through the Technical Committee or that their classification as standard articles of equipment was formally approved by higher authority outside the Medical Department. However, no serious difficulties appear to have been encountered as a result of these omissions. Procurement action was initiated without delay by employing the same basis of issue and requirements estimates as had been previously applicable to the standard straight and folding pole aluminum litters. While, as mentioned earlier in this study, failure to investigate fully the sources of supply for the straight pole laminated wood litter may have led to the standardization of an item which was at that time procurable in only limited quantity, the sudden removal of aluminum tubing from the critical list made further purchase of the straight wood litter unnecessary. Whatever production problems might have existed, therefore, never became actual problems.

In conclusion it may be noted that Medical Department conformance with standardization regulations steadily improved with the passage of time. In 1941, only one item out of three was standardized in the manner prescribed by AR 850-25. In 1943, two out of the three items adopted were correctly processed. In 1944 a perfect record was achieved with six items out of six standardized in strict accordance with Army Regulations.

## 2. Item Evaluation.

Of the 14 items discussed in this study, only two (the medical laboratory trailer and the snow and ice ambulance) failed to be adopted by the United States Army as standard articles of military equipment. Even in the projects in which these failures occurred, however, satisfactory end-items (the medical laboratory truck and the toboggan litter adapter) were later developed and approved for standardization. Each project included in this monograph, therefore, yielded at least one acceptable product. The straight pole litter project yielded two: the straight steel litter and the straight wood litter.

Comparing these 12 standard items with the equipment which had previously been used by the Medical Department for the same or similar purposes, improvement can be noted in each instance. Generally speaking, the new



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litters and litter adapters represented the least radical departures in construction and design, since development work had been guided to a considerable extent by earlier standard models. Even here, however, numerous technical and mechanical advances were made.

In the straight and folding pole litter projects, not only were suitable substitutes for aluminum side poles discovered (carbon steel and laminated wood) but a universal undercarriage adaptable to all Medical Department litters and constructed entirely of pressed steel was also developed. In the case of the folding wood litter, basic design was altered materially to provide for double-folding side poles and channel hinges in place of the single-folding, link-hinged poles of the earlier aluminum model. As for the new ski litter adapter, this item too was superior to its predecessor. The 1935 ski clamp had been a permanent attachment and, as such, had required a specially prepared set of skis. The new clamp, on the other hand, was detachable. It could thus be used, without previous preparation, with any type of standard ski or litter.

The toboggan litter adapter and the amphibian litter stop were largely pioneer developments. Aside from certain relatively crude field improvisations, no previous experimentation appears to have been conducted along these lines by Army personnel.

Turning now to the vehicle projects, the contrast between the new and the old was even more marked. In only one instance (the optical repair truck) had any type of self-contained motorized unit previously existed, and in this case the earlier vehicle was simply a stake-and-platform type of open cargo truck, tarpaulin-covered, and equipped with only a limited amount of interior fittings. In all other instances the new specialized medical vehicles were literally without precedent.

Compared with the earlier system of packing equipment in Medical Department chests, loading these chests on general cargo trucks, and then unloading and unpacking all equipment upon arrival at the destination point--the simplified operation made possible by the development of self-contained medical vehicles was a striking advance. In place of open cargo trucks, fully enclosed and specially designed truck bodies were provided. Built-in cabinets were available for the storage of equipment and supplies, thus eliminating the necessity for repeated packing and unpacking operations. Finally, the provision of heating, lighting, and plumbing facilities made possible the performance of laboratory,

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clinical, or operating work within the body of the truck and on a twenty-four hour basis.

Considering next the extent of wartime usage which each of the foregoing items received, it will be seen that, on the whole, litters and litter adapters went into production earlier than the specialized vehicles and consequently, on the average, saw a greater amount of actual field service. Excluding the ski litter adapter which was not procured in quantity until after the war had ended, the average time-span between the date of first equipment deliveries and the date of official conclusion of the war VJ-day amounted to 27 months for litters and litter adapter as against 18 months for the specialized medical vehicles. In two of these latter instances, moreover, (the dental operating truck and the medical laboratory truck) considerably less than a year's overseas service was attained.

As for total procurement--a second index of the extent of wartime usage--the straight steel litter stands out as the key item in the Medical Department litter program. Over 470,000 of these items had been produced and delivered by January, 1945, as against approximately 69,000 folding wood litters, and slightly more than 5,000 straight wood litters. From these data it is evident that the straight steel litter served as the backbone of the system of medical evacuation in World War II. However, the relatively high procurement of the folding wood litter indicates the large extent to which this item, which was designed mainly for Army Air Forces, was employed in air evacuation. The remaining items in this category were of progressively less procurement importance. Approximately 2,500 amphibian litter stop attachments and slightly more than 300 toboggan litter adapters were produced and delivered during the war period. While over 1,000 ski litter adapters were ordered, none of these appear to have been delivered before VJ-day.

Of the six vehicle developments, first in procurement importance and overseas urgency were the surgical and surgical operating trucks. More than 200 of each of these two vehicles were delivered during the war years. Occupying a middle position were the dental operating and dental laboratory trucks, with procurement totals of 138 and 107, respectively. Behind these was the medical laboratory truck of which 77 were produced during the period, while in last position was the optical repair truck with a total of only 24 produced and delivered by VJ-day.

As for the first-hand evaluations by field personnel who actually used this equipment during the war, no systematic method of ascertaining these reactions appears to have been established by the designated using arms and



services. Few references of this nature were included in the Essential Technical Medical Data reports received each month from overseas theaters and few direct comments on medical field equipment developments ever reached the Medical Department through official correspondence channels.

In view of data limitations, therefore, no conclusive answer to this question can be given. It can only be said that a sampling of annual and quarterly historical reports submitted to The Surgeon General's Office by medical units serving overseas and in the Zone of the Interior indicates a generally favorable reaction and interviews with medical personnel recently returned from overseas tend to confirm this positive impression.

## II. Analysis of Administrative Trends.

### A. Coordination and Direction of Research and Development.

It has been noted in previous sections of this chapter how, from 1939 through 1944, highly decentralized and disorganized project direction was gradually succeeded by a more and more centralized and efficient managerial system. This steady improvement in project administration was evidenced in many ways: in the increasing precision and thoroughness with which military characteristics were formulated; in the closer liaison relationships that were established with participating manufacturers; in the more careful coordination of administrative action with interested Medical Department agencies and with interested arms and services; and, finally, in the increasing efficiency with which standardization action was initiated and carried through to completion.

Coinciding in point of time with these favorable administrative developments were certain organizational changes which were taking place within The Surgeon General's Office.<sup>14</sup> From 1939 until 1942, research and development functions were divided between the Planning and Training Division, the Medical Department Research Coordinating Board, the Finance and Supply Division, and a number of professional divisions, each possessing a considerable degree of autonomy within its own special field. In May, 1942, a Research and Development Division was created and the major responsibility for the supervision and coordination of medical research and development transferred to this agency. However, certain research functions still remained in various branches of the Supply Service, Professional Service, and Operations Service, and it was not until February, 1944, with

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the establishment of the Technical Division that the culmination of the long trend toward centralization and unification of research and development activities was at last achieved.

That improvement of project administration was the underlying purpose of these several organizational changes is clearly indicated in the investigation reports which preceded and led to both the 1942 and 1943 reorganizations. It is equally evident that there was a growing conviction on the part of key research and development personnel that centralization of research responsibility was the only answer to these administrative problems. Centralization was the dominant theme of the special board report of 3 January 1944, of which the following is a sample excerpt:

It is believed apparent that the approach to a solution of the problems outlined above must be along the lines of maximum centralization of responsibility for the several related activities. The present duplication, triplication and even quadruplication of interest and responsibility in research and development matters is believed to have resulted in large part from the gradual but enormous expansion of this office without entirely adequate reorganization on a functional basis . . . . In contrast it should be noted that all technical services other than the Medical Department concentrate all research and development activities in a single unit.<sup>15</sup>

On the basis of the foregoing data, the following general proposition is advanced: The more centralized and integrated the organization for research and development, the greater the degree of administrative efficiency in the conduct of these activities.

B. Technical Aspects of Research and Development.

It has already been pointed out that the items produced under the Medical Department litter program were, on the whole, developed sooner and, consequently, saw a greater amount of actual field service during World War II than those developed under the Medical Department vehicle program. There were, of course, a number of inherent differences between the two undertakings--differences in costs, availability of materials, relative difficulty of the research problems



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involved, and degree of dependence upon other arms and services for technical assistance. One further factor emerges from the data, however, which would appear to be equally deserving of inclusion as a part of the total explanation for the differing speed with which technical research and development was accomplished in these two major programs. This was the factor of peacetime research and development.

During the period between World War I and World War II, the funds available to the Medical Department for the conduct of research and development were unbelievably small. During the 20's, when federal expenditures in all fields were being held to a minimum figure, allotments for medical research and development were virtually non-existent. Even with the sharp rise in governmental appropriations following 1933, available research funds were minimal. In 1935, 1936, and 1937 only \$1,500, \$2,500 and \$4,000, respectively, were allocated by the Medical Department for these purposes.<sup>16</sup>

With these financial limitations in mind, it is not difficult to see why, in the peacetime period, developments in the field of litter construction and design far outstripped those in the vehicle field. In the former instance, since material costs were nominal and since the litter, being a basic item of medical equipment, would be required in large quantity in the event of war, many manufacturers were willing to engage in experimentation on a cost-free basis in the hope of developing new models acceptable to the Medical Department. By thus farming out the major portion of this experimental work, research and development personnel were able to conduct relatively large-scale investigations in this field with a minimum of expense. The results speak for themselves. During the middle 30's new straight and folding aluminum litters were developed and standardized which were superior in virtually every respect to their World War I counterparts. Upon the outbreak of war, therefore, the only additional experimentation required in this field was the discovery of suitable aluminum substitutes and the development of a small number of litter adapters. Basic litter design had been established by peacetime research.

By way of contrast, vehicle experimentation during the pre-war period was seriously inhibited by lack of funds. Here, material costs were high and it was also evident that even in the event of war the number of specialized medical vehicles which would be required would be relatively small. The necessary inducements for manufacturer-participation did not, therefore, exist. The Medical Department was dependent upon its own funds, its own facilities, and its own personnel for whatever progress was to be made. The sequel was disappointing but, under the circumstances, hardly surprising.

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As early as 1933, the Medical Department established a formal development project to produce a self-contained mobile medical laboratory unit. Due to lack of funds, this undertaking remained dormant until 1939 when \$500 was allocated to the project. A trailer type of vehicle was obtained, as had been the original plan in 1933, and two years were spent in designing, construction, and service testing this model. Because of unsatisfactory field performance the trailer laboratory was rejected. With the inadequacy of the trailer type of vehicle now demonstrated, in October, 1941, a new project was launched--the Armored Force surgical truck project--to investigate the possibilities of converting a prime-mover type of vehicle into a self-contained mobile unit. A year later this undertaking was successfully concluded and the Medical Department at last had a suitable basic model for its specialized vehicle program.

It would appear evident from the above account that inability to conduct trailer experimentation in 1933 and learn the lessons that were to be learned from this experience during peacetime years had simply postponed these preliminaries until wartime. This latter period, it will be appreciated, was one in which the Medical Department could least afford a two-year delay in a major research program.

In the light of these data the following general proposition is advanced: There is a direct relationship between the quantity and quality of peacetime research and development, and the speed and effectiveness of wartime research and development.

C. The Conduct of Engineering Tests.

Although the Medical Department was responsible for the conduct of engineering tests of all new items of medical field equipment, the data have shown that in only one instance (the medical laboratory trailer) were such tests satisfactorily performed and adequately reported upon. These omissions, however, were attributable in only small part, if at all, to negligence on the part of medical research and development personnel.

In the case of litter projects, the Equipment Laboratory did not possess the necessary equipment to conduct static load tests and was hence dependent upon private manufacturers or the Aero Medical Laboratory at Wright Field for such engineering tests as were performed. In the case of the vehicle projects, however, an entirely different problem was presented. Here, no elaborate testing devices were required. All that was needed was sufficient trained personnel to conduct extended road tests and to make and record during these



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tests appropriate technical observations regarding the mechanical adequacy of the vehicle and of interior packing arrangements.

That personnel was not available after 1941 for the performance of these tasks is evident from the data. The reason for this deficiency would appear to be as follows. It will be recalled that approximately two to six months were required for the conduct and reporting of service tests by designated using arms and services. In the case of the dental laboratory truck, the dental operating truck, the optical repair truck, and the surgical operating truck, the need for these vehicles was too urgent to permit such an extensive time-lapse for service testing. As a necessary expedient, therefore, these tests--though actually a using agency responsibility--were performed by the Medical Department. Under these circumstances, neither the time nor the personnel was available for the conduct of engineering tests which, though desirable, were regarded as less essential than full field trials.

On the basis of the foregoing analysis, the following proposition is advanced: Except where suitable testing equipment was not available, the failure of the Medical Department to discharge satisfactorily its engineering test responsibilities was largely due to failure on the part of using arms and services to relieve the Medical Department of all service test responsibility.

D. The Conduct of Preliminary Research Investigations.

It has been observed in earlier sections of this chapter that, on the whole, little preliminary research investigation was conducted in any of the projects with which this study has dealt.

On the basis of first-hand study of the research procedures followed at the Equipment Laboratory at Carlisle Barracks and on the basis of considerable day-to-day association with research and development personnel in The Surgeon General's Office, the following proposition is offered: Office procedures, funds, personnel, and equipment necessary for the adequate performance of preliminary research investigations were lacking at the start of the war, and this deficiency was not remedied at any time during the course of the war.

E. Establishment of Military Requirements for New Development Projects.

The data previously discussed have shown that, in only two instances out of eleven, did a using arm or service submit written evidence of the existence of a definite military requirement for the development project concerned. While the Medical Department gradually developed certain informal procedures of its own for the evaluation of requests for new items of equipment and for the assignment of research priorities, these efforts were at best half-measures as the Medical Department possessed no legal authority and, hence, could build no adequate formal organization for the conduct of such overseas surveys.

The proposition is therefore advanced that: Because of the failure of using arms and services to discharge satisfactorily their responsibilities under Paragraphs 5, 6, and 8 of AR 850-25, adequate procedures were lacking throughout the war for the establishment of sound military requirements for new development projects.

III. Conclusion.

Both from a qualitative and quantitative standpoint, the achievements of Medical Department research and development personnel in World War II were impressive. Out of the 14 new items of medical field equipment described in this study--and every effort was made to select a representative sample--12 were of sufficient merit to warrant standardization and quantity procurement, and at least nine of these items saw extensive battle service.

While the importance of these accomplishments is fully recognized, it is the belief of the authors of this monograph that an even better record can be achieved in the future by the Medical Department if equal attention is given to certain of the deficiencies disclosed by this study and appropriate action taken to prevent their recurrence.

On the basis of the trend-analysis just presented and in the light of numerous discussions with research and development personnel during the eighteen-month period when this study was being prepared, the following specific recommendations are suggested:

- (1) that, however sharp the reduction in medical research and development activity during the peacetime period, all managerial functions continue to be maintained in a single agency, even though that agency be of only branch status.



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- (2) that in future war plans prepared by the Medical Department, definite provision be made for the prompt establishment of an adequately staffed and adequately financed independent agency, responsible directly to The Surgeon General or his Deputy, to coordinate and supervise all types of wartime research and development.
- (3) that, whatever the size of the annual appropriations received by the Medical Department during the post-war period, an appreciably higher percentage of these funds be devoted to research and development activities than was the case during the years 1920-1940.
- (4) that the funds, personnel, and physical facilities needed for the conduct of adequate preliminary research investigations be immediately provided and that, to insure compliance with Army Regulations, The Surgeon General require written evidence of the satisfactory accomplishment of these procedures as a routine prerequisite to approval of new development projects.
- (5) that the appropriate provisions of AR 850-25 be revised to provide for the establishment of cellular teams of overseas observers, organized preferably at the War Department level, whose specific responsibilities will be to investigate and evaluate overseas demands for new items of equipment and to recommend, when deemed necessary, the establishment of new development projects to produce these items.
- (6) that the number of service testing stations operated by using arms and services be materially increased to provide for year-round testing of all types of equipment; that the duration of the testing period be shortened to the degree consistent with accuracy and reliability; and that effective procedures be established to insure prompt processing of all correspondence and formal reports incident to such testing.

FOOTNOTES TO CHAPTER XI

- <sup>1</sup>AR 850-25, Par. 8. See also Pars. 5 and 6.
- <sup>2</sup>Ltr. to Chf., Field Equipment Br., Plans Div., fr. Dir., Research and Development Div., S.G.O., 10 Dec. 1942; subject: "Medical Equipment for Mountain Troops" (A.M.R. & D. Bd.).
- <sup>3</sup>Supra, p. 232.
- <sup>4</sup>AR 850-25, Par. 10.
- <sup>5</sup>Supra, p. 226.
- <sup>6</sup>AR 850-25, Par. 9c.
- <sup>7</sup>One of the authors (Lt. Wilson) served as a member of the Supply Coordination Branch of the Technical Division, S.G.O. from February, 1945 to September, 1945. The other author (Lt. Johnson) occupied desk space in the Research Coordination Branch of the Technical Division, S.G.O. from December, 1944 through May, 1945.
- <sup>8</sup>AR 850-25, Par. 11b.
- <sup>9</sup>The "Stretcher-Kot" submitted by the American Pressboard Company might be considered analogous to the military ski litter adapter, but it employed neither a standard litter nor a standard ski.
- <sup>10</sup>Supra, pp. 250-251.
- <sup>11</sup>Supra, p. 73.
- <sup>12</sup>AR 850-25, Par. 12.
- <sup>13</sup>Ibid., Par. 16.
- <sup>14</sup>See monograph by Chf., Research Coordination Br., Tech. Div., S.G.O., History of World War No. II from 1 January 1939 to 30 June 1944, SECRET, (Hist. Div., S.G.O.). Extracted in clear.
- <sup>15</sup>Medical Research and the Development and Classification of Medical Department Items of Supply and Equipment, 3 January 1944; included as Exhibit "A" in Five-Year History of Development Branch, Technical Division, Operations Service (Hist. Div., S.G.O.).
- <sup>16</sup>The Army Medical Bulletin, No. 32, July, 1935, p. 75.



APPENDICES





Appendix A

DECISIONS REACHED AT CONFERENCE HELD 6 JULY 1942 AT KRIEGER PLANT BETWEEN REPRESENTATIVE OF MEDICAL DEPARTMENT EQUIPMENT LABORATORY AND KRIEGER COMPANY, CLARIFYING SPECIFICATIONS AND DRAWINGS OF SURGICAL TRUCK

- "1. Water Tank to be a standard 50 Gallon Galvanized Tank, having approximate dimensions of - length 60", diameter 16".
- "2. Water Tank to be equipped with a Visual Reading Float type gauge similar to that manufactured by the Rochester Manufacturing Company.
- "3. Rear Step to be standard  $\frac{1}{2}$  ton Dodge Ambulance folding step as manufactured by the Wayne Works, Richmond, Indiana.
- "4. Moulding - Exterior of Body moulding to be either solid or snap-on type.
- "5. A Rainproof Convenience Outlet wired into the truck electrical system to be provided at a convenient location on each side of the exterior of the body.
- "6. Equipment Laboratory to furnish two (2) Floor Plates to Krieger Steel Sections, for the Pilot Model.
- "7. Dome Lights as specified on Equipment Laboratory drawings to be any standard commercial car light.
- "8. All wiring to be surface mounted on top of interior masonite lining and covered by a rectangular steel section; this steel section to be secured to the masonite by screws placed on approximate 12" centers.

"9. A Master Switch to be installed on the dash to control all interior body lights.


"10. Equipment Laboratory will furnish a color sample of the interior paint.

"11. In lieu of the double glass dehydrated windows specified, single pans Safety Plate-Windows equipped with a pullman-type mechanized to be supplied on all windows and to be equipped with galvanized drip pans."



Appendix B

TEXT OF LETTER OF 8 JULY 1942 FROM MEDICAL DEPARTMENT  
EQUIPMENT LABORATORY SUPPLYING KRIEGER STEEL SECTIONS,  
INCORPORATED, WITH SUPPLEMENTARY INFORMATION RELATIVE  
TO DRAWINGS AND SPECIFICATIONS AS REQUESTED BY TELEPHONE



"In accordance with our conversation yesterday we are forwarding you via railway express (one) 1 operating light and two (2) Carlisle model floor plates. These floor plates were obtained by us from The Aluminum and Brass Company, Lockport, New York, at a cost of \$1.20 each. The brass floor plate has been superseded by cast iron and we do not know whether the Aluminum and Brass Company can supply these in this material. We are inclosing four (4) copies of our Drawing No. 1246 showing the design of this cast iron floor plate. The New York Medical Depot, Brooklyn, New York, has recently purchased a large quantity of these cast iron plates and we are writing them requesting that they inform you as to their source of supply; should you not hear from them within a few days please let us know.

"A color sample of the paint for the interior finish is inclosed. This particular paint is made by the Beckwith-Chandler Company, Newark, N. J., and is their No. 630, light green semi-gloss industrial lacquer. We wish to mention that the paint you supply for the interior does not have to duplicate this sample exactly but should approximate the color; either lacquer or enamel may be used.

"We contacted Mr. F. A. Keihn of the Evans Products Company this morning re the Evans heating unit. Mr Keihn just called back and informed us that he contacted his home office in Detroit and that every effort will be made to supply you with a heater. Mr. Keihn expects to visit you this afternoon or in

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the morning. If he has not contacted you by this time you receive this letter, please let us know by phone.

"Major Christie and myself wish to thank you personally for the many courtesies extended us while at your factory."

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Appendix C

NOTES ON CHANGES TO BE INCORPORATED INTO PRODUCTION  
MODELS OF SURGICAL TRUCKS AS AGREED UPON AT CONFERENCE  
AMONG REPRESENTATIVES OF KRIEGER STEEL SECTIONS, HOLA-  
BIRD QUARTERMASTER DEPOT, AND MEDICAL DEPARTMENT EQUIP-  
MENT LABORATORY HELD AT CARLISLE BARRACKS 21 JULY 1942

"In lieu of 50 gallon water tank and water heating coil as  
provided at present, a separate water heating system (of a  
design to be supplied by the Equipment Laboratory) to be  
furnished by contractor:

A float level gauge is to be provided on water tanks.  
Mixing faucet and sink to be as at present.

"2. In lieu of the lighting system specified the following  
to be provided:

The two 6 volt dome lights as at present to be connected  
to electrical supply of truck; cab switch required.  
Clear glass to be provided in dome lights.

A complete 110 volt lighting circuit including the  
following to be installed by contractor:

Operating light to be 110 volts installed as at present.

Operating lights will be furnished by the Medical  
Department Equipment Laboratory to the contractor.

A fused entrance switch mounted inside the body shall be  
provided.

All wiring to be surface mounted in conduit. The above to be in accordance with the wiring diagram to be supplied by the Medical Department Equipment Laboratory.

"3. Rear doors to be equipped with two stage stops, one stage providing a door opening of approximately 170 degrees. Each door to be provided with a slam type locking mechanism with one locking handle. Door keys to be provided in triplicate, not Government coded. Handle to be provided for opening rear door from inside.

"4. Six gooseneck lights of a design to be furnished by the Equipment Laboratory to be supplied by the contractor. Four saddlers loops (two on each side of body) for fastening these lights to be supplied by the contractor.

"5. Funnel for filling water tanks (of a type specified by the Medical Department Equipment Laboratory) to be provided by contractor.

THE FOLLOWING CHANGES AND MODIFICATIONS NOT INVOLVING ANY ADDITIONAL COST TO THE KRIEGER STEEL SECTIONS, INC., ARE TO BE MADE ON ALL PRODUCTION MODELS:

"1. Water heating coil to be eliminated from Evans heater. All heater fans to be operated from 110 volt, 60 cycle a.c.

"2. Skirting on body to be eliminated.

"3. Spare tire to be located on left hand body side in accordance with blue print to be furnished by Holabird Quartermaster Motor Base.

"4. Filler neck on gasoline tank to be located to provide easy access.

"5. Install removable service plate for folding rear step mechanism on each door.

"6. Install shelf on right hand side of wood cabinet.

"7. Install divider in wood cabinet.

"8. Close left end of wood cabinet.

"9. Check rear windows for sufficient space to install black-out curtains; if necessary decrease size of window.

"10. Steel ladder to be installed on front of body in accordance with original specifications.



"11. Install parcel racks on each side in accordance with original specifications.

"12. Steel cabinets to be in accordance with latest revisions of Medical Department Equipment Laboratory Drawings Nos. 2258, 4259, 3260, 3261, 2263, D-295, D-296, D-297, and D-298."





Appendix D

REPORT OF ARMORED FORCE BOARD, FORT KNOX, KENTUCKY,  
ON PROJECT NUMBER 291: TEST OF SURGICAL TRUCK AND TENT,  
DATED 26 AUGUST 1942

THE ARMORED FORCE BOARD

Fort Knox, Kentucky

EJB/mvm

AFB P-291

August 26, 1942

TEST OF SURGICAL TRUCK AND TENT.

1. PROJECT: Test of Surgical Truck and Tent.

a. Authority.--Letter, Armored Force Board, Fort Knox, Kentucky, August 18, 1942, file AFB 451.8 and 1st Indorsement, Headquarters Armored Force, August 18, 1942, file 451.2-112, GNOHD (8-15-42).

b. Purpose.--To determine the suitability of the surgical truck and tent for the Armored Force.

2. DISCUSSION:

a. Description:

(1) Surgical Truck.--The surgical truck consists of a van type body mounted on a standard, 6 x 6, 2½-ton truck. Mounted within the van body were the following facilities:

- (a) Water tank - 50 gallon capacity.
- (b) Air circulating fan.
- (c) Sink with hot and cold water outlet.
- (d) Cabinets for equipment, supplies and accessories.
- (e) Two dome lights - 6 volt.
- (f) One dome light (operating) - 6 volt.
- (g) Cabinets for the stowage of equipment and supplies.

Outside of the van body were the following facilities:

- (a) Combined air-water heater on left front body.
- (b) Fuel tank, gasoline, 6-gallon capacity for air-water heater, located above and to right of cab.
- (c) Electrical connections for homelite or other source of current.

The interior of the van body was wired for 6 volt current only. The weight of the body and all equipment was estimated to be 1800 pounds. For further details see photographs No. 3860 to 3864, inclusive.

(2) Surgical Truck Tent.--The surgical truck tent was fabricated at the Jeffersonville Quartermaster Depot according to the design presented by the Armored Force Board Report, AFB P-224, "Tent for Operating Room Truck," May 29, 1942. Certain changes were necessary in order to conform to the design of the surgical truck. These involved essentially the following:

- (a) Greater height where the tent passes over the van body.
- (b) Two side ventilators in place of one above the cab.
- (c) Straps to fasten the canvas to the front and top of the surgical truck.

The tent is constructed of heavy canvas treated for blackout characteristics. The tent weighs



approximately four hundred (400) pounds. The tent dimensions are as follows:

Length -  $22\frac{1}{2}$  feet

Width -  $25\frac{1}{2}$  feet

Height - 11 feet (approximately) at the top of the van body, 5 feet and 6 inches at the side walls.

Entrance to the tent is from the rear through a hanging flap. A canvas fly extending at an angle of  $45^{\circ}$  from the left side of the entrance prevents the escape of light during night operations. For further details see photographs No. 3860 to 3864, inclusive.

b. Details of Tests.--The surgical truck and tent were subjected to test as follows:

(1) Cross-country operation.

(2) Pitching and striking of tent.

(3) Blackout characteristics.

(4) Inspection by Armored Force Medical Officers and demonstration to Medical personnel.

c. Results of Tests :

(1) Surgical truck,  $2\frac{1}{2}$ -ton, 6 x 6, with van type body.

(a) Cross-country characteristics.--The tests indicate that the truck has excellent cross-country ability, equal to that of the standard  $2\frac{1}{2}$ -ton, 6 x 6 truck. The added height of the van body (approximately one and one-half ( $1\frac{1}{2}$ ) feet) will cause some difficulty when traveling through wooded areas. The load of the surgical truck is estimated to be as follows:

Van type body	- 1000 pounds
Tent	- 400 pounds
Equipment & Supplies	- 1000 pounds
Total	- 2400 pounds

It is evident that the truck is well under its payload capacity.

(b) Accessories, Equipment and Facilities on or within the Truck Body.--The pilot model surgical

truck was not complete nor fully equipped. The following discussion will consider the desired features.

1. External sources of electricity (as from a Homelite or similar generating system) must be made available. This is necessary in order to conserve the battery and provide ample power for fans, sterilizers, and operating lights. A portable 1500 watt, 110 volt generator is being considered. Since this unit generates current at 110 volts, it is necessary that the interior of the truck be wired and fitted with accessories for such current. It is suggested that this generator be suitably mounted on the front of the truck body, above the driver's cab and between the air-water heater and fuel tank for the same. It is believed a type of mounting can be utilized to prevent vibration, and that an adequate muffler (possibly using a 6 x 6 truck muffler) would reduce noise satisfactorily. The type of mounting should be such as to make the generator easy to dismount and place on the ground outside the tent for operation.

2. The truck must be wired for current available from the truck power supply as well as from external sources.

3. Four brackets on the outside of the truck body (two brackets on each side) are required for light purposes within the tent.

4. Outlets within the body are required as called for by drawings No. SK 51, Wiring Diagram, Surgical Truck.

5. An additional ventilating fan should be provided for the adequate ventilation of the truck body. This fan could be located at the front of the van body and just above the sink. The circulating fan connected to the air-water heater provides only hot air for the truck body. As an alternative, separate air and water heaters are suggested. The fan on the air heater could then be used for circulation of warm or cold air as required. The air heater can be installed on the van body to the right of the driver's cab.

6. Cabinets No. 19, Drawing No. 3260, and Cabinets No. 20, Drawing No. 3261, have drawers which are too small. Compartments fitted with sliding doors and having dimensions of approximately 21" x 19-7/16" are more desirable. Two rows of small drawers 10-2" x 4-9/16" at the top of the cabinets are ample.



7. Drawer latches must be more substantial and more readily operated. The latches failed to hold the drawers in position in many cases during cross-country operation and in other cases would not permit the drawers to be pulled out.

8. The wing nut method of holding the burner lighting door in place on the air-water heater, is unsatisfactory. During long cross-country operations the wing nuts will loosen and the door will be lost. Provisions must be made to prevent this.

9. The spring operated door of the heater through which regulation of the burner draft is accomplished is unsatisfactory. The door and door springs are light weight material and the springs will fail after a short time. A heavier hinged door with positive locking device is suggested.

10. The fuel metering valve assembly is susceptible to damage when operating through brush or timber. The assembly should be more rugged and amply protected against damage.

11. Brackets around the front sides and top of the truck for attachment of tent straps should be factory installed.

12. The sink drain pipe discharges upon the muffler and thence on the ground within the tent. The sink drain should be carried to the front of the truck and discharged into a soakage pit prepared for that purpose.

(2) Tent Surgical Truck.

(a) No difficulties were experienced in pitching or striking the tent provided that the tent was folded in such a manner that it may be hoisted over the drivers cab and to the front top of the van body and then unfolded from the top of the van body.

(b) Blackout Characteristics.—In general the tent has good blackout characteristics. No light was observed to pass through the material or through the rear entrance when the movement of casualties was simulated. Some reflected light did escape from the front of the truck at the junction of the canvas and the truck body. This was due to poor contact of the inner canvas flap to the body of the truck. This contact may be improved by providing a grommet and rope over the truck body and fastening down tightly on the opposite side. A strip of canvas is stretched under the truck chassis just below the

front of the truck body. This canvas prevents the escape of light except when light rays are directly under the body of the truck. Such light is visible only when observers lie on the ground. A very small amount of reflected or even direct light escapes from the front tent ventilators. The escape may be prevented entirely by lowering the ventilator covers.

(c) Large amounts of dust, mud, and dirt are introduced into the body of the truck when the folded tent is carried therein. It is suggested that the folded cover be carried in a baggage rack on top of the drivers cab and held down by means of a tarpaulin and ropes. The tarpaulin could be used to prevent reflection from the windshield when the truck is in use as an operating room truck.

3. CONCLUSIONS: The Armored Force Board concluded that:

a. The truck, surgical, 2- $\frac{1}{2}$ -ton, 6 x 6, has the required cross-country mobility for Armored Force use.

b. The accessories, equipment and facilities are adequate except as indicated under 2c (1) (b).

c. The tent for the surgical truck is satisfactory except for improvement in blackout features as stated under 2c (2) (b).

d. The folded tent should be carried on top of the drivers cab in a suitable rack and held down by means of a tarpaulin and ropes.

4. RECOMMENDATIONS: The Armored Force Board recommends that:

a. The truck, surgical, 2- $\frac{1}{2}$ -ton, 6 x 6, be standardized for issue to the Armored Force after modifications as indicated above have been made.

b. The tent, surgical truck be standardized for issue to the Armored Force after modifications as indicated above have been made.



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c. Provisions be made for carrying the folded tent on the top of the driver's cab.

/s/ G. B. DEVORE  
G. B. DEVORE  
Colonel, Armored Force  
President

1 Incl:

Photographs. [Stamped:]

Headquarters Armored Force  
Fort Knox, Kentucky

Approved Sep 7 1942

For the Commanding General:

/s/ LEO E. SCHULTEN, JR.  
Major, A. G. D.,  
Asst. Adjutant General.

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Appendix E

TEXT OF MEDICAL DEPARTMENT LABORATORY REPORT ON ROAD  
TEST OF TRAILER LABORATORY, DATED 25 APRIL 1941

"1. The semi-trailer unit left the Laboratory at 1:03 P.M., April 24, 1941. The equipment carried in the trailer consisted of glassware, microscopes, etc.

"2. The attached chart is a log of the trip. The total mileage of the trip was 60 miles of which 9 miles were traveled on concrete roads, 40 miles on macadam roads, and 11 miles on dirt roads. The gas used on the 60 mile trip was 13 gallons.

"3. The power unit controlled the trailer very well, except that a pushing-pulling motion could be felt in the cab. This could have been caused by a worn coupling of the power unit. When the brakes were applied suddenly, the trailer would push the power unit. This could probably be taken care of by adjusting the brakes on the trailer. The trailer unit rode very well; it had a gentle up and down motion, and a side motion on macadam roads, and the same motion but more severe on rough dirt roads which made it difficult for the rider to keep on his feet during the time he was riding in the trailer. The average speed traveled on macadam roads was 25 m.p.h., and on dirt roads, 25 m.p.h. and at these speeds the trailer rounded curves without excessive leaning or swaying. The height of the trailer being 11 feet (plus or minus), low hanging branches of trees on the dirt roads would strike the front and top portions of the vehicle, and at times fairly large branches would strike the windows in the front of the trailer. The windows having no protective curtains could easily have been broken. The driver took a wrong turn and entered a small park with a narrow winding road bordered with trees. Upon

finding his mistake the possibility of backing out was examined but rejected as there were a number of trees with low branches which would surely be broken in maneuvering so large a vehicle. This made it necessary to continue through the park which was difficult due to light wires, tree branches and trees that had to be avoided.

"4. The following is a list of the equipment that needs adjustment in the trailer:

Sterilizer has a chafing noise in water holder.  
 Metal strap on sterilizer door needs tightening.  
 Sterilizer frame could be cross braced.  
 Top rear drawers on the right side cannot be opened when vehicle door is closed.  
 Fuse box door is hard to close.  
 Center light, left side, needs tightening.  
 Windows do not fit tight at top.  
 Generator and motor bouncing around, need fastening.  
 Board under motor cracked.

"5. The complete unit shows good roadability over all types of roads. It exhibits comparatively easy handling, and the power unit can pull the trailer without effort notwithstanding the fact that it is necessary to use low gear on long hills."

Project F-3 (Cont'd)  
Road Test, Laboratory,  
Semi-trailer

Road Test,  
April 24, 1941

Total Mileage - 60 miles  
 Gas used on trip - 12 gal.

Time	Speedometer		Miles	Type of Road Condition	Remarks
	Start	Finish			
P.M.				Macadam	
1:03	30058	30060	2	good	Recorder riding in cab on post - driving slow.
1:07	30060	30066	6	Concrete good	Driving at 30 to 35 mph, Some feeling of back and forth movement (may be caused by worn coupling on power unit). Applied brakes suddenly and could feel pushing action of trailer on power unit



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Time	Speedometer		Miles	Type of Road	Remarks
	Start	Finish			
					(this action may be stopped by adjustment of brakes on trailer).
1:19	30066	30069	3	Dirt rough	Recorder in trailer. Driving at 20 MPH. Chafing noise in sterilizer. Top right rear drawers of cabinet cannot be opened when rear door is closed. Generator and motor bouncing around in cabinet.
1:31	30069	30071	2	Macadam	Driving at 30 mph. Riding fairly smooth. Chafing in sterilizer. Generator motor bouncing. Fuse box hard to close.
1:39	30071	30073	2	Dirt rough	Driving at 30 mph. Trailer taking 90° turns with out leaning more than could be expected. On small country road, branches of trees, some fairly large, striking bus in front windows; danger of breaking as windows are unprotected.
1:45	30073	30075	2	Macadam	Driving at 35 mph. Recorder in cab.
1:50	30075	30076	1	Dirt poor	Driving at 25 mph. Short steep hills. Unit taking curves without affecting the driving.
1:55	30076	30079	3	Macadam good	Driving at 30 mph.
2:00	30079	30081	2	Dirt Improved	

Time	Speedometer		Miles	Type of Road	Remarks
	Reading				
	Start	Finish		Condition	
2:07	30081	30090	9	Macadam	Took wrong road through park. Trouble getting under wire and low branches of trees. Road winding; impossible to back out. Left park and continued at 30 mph around curves without side sway. Riding at 35 mph on straight road, trailer riding smoothly.
2:40	30090	30093	3	Dirt	Power unit pulling hard on steep hills.
2:50	30093	30094	1	Improved	
2:52	30094	30097	3	Macadam	
				Concrete	
2:56	30097	30118	21	Macadam	Recorder riding in trailer. Trailer unit holding road, very little side sway; constant up and down rhythmic motion. Center light, left side loose. Climbing Sterretts Gap slow but steady; power unit pulling hard in low gear. At this speed trailer riding quite smooth. Glassware joggling in drawers, not hard enough to cause damage. Microscope front left not firm on floor. Door strap on sterilizer needs adjustment.
4:00	30118				Returned to Equipment Laboratory. Glassware checked; nothing broken.



"1. The Army laboratory semi-trailer was taken on a road test of 81 miles of roads on April 25, 1941, as follows:

"a. Thirty-two (32) miles of concrete roads, State Highway type.

"b. Thirty-four (34) miles of macadam roads, nine (9) miles of which were mountain roads.

"c. Fifteen (15) miles of gravel covered dirt roads..

"2. Speed varied from 5 miles per hour over the mountain roads to 35 miles per hour over concrete roads. Average speed for entire 81 miles was 23.1 miles per hour.

"3. Weather and road conditions were ideal.

"4. The road test was uneventful. Inspection at end of road test did not disclose any apparent damage or breakage of the equipment carried in the laboratory."

"1. The Army laboratory trailer was driven a total of 73 miles over all types of roads, this morning, as follows:

Dirt and stone -----	15 miles
Macadam -----	36 miles
Concrete -----	22 miles

"2. The dirt and stone roads were very rough and could not be traversed at a speed greater than 15 miles per hour; Approximately 11 miles of the macadam roads were rough, necessitating reduced speed (15 to 25 miles per hour). The balance of the mileage permitted a speed of 30 to 40 miles per hour.

"3. An inspection of the equipment in the trailer at the end of the run disclosed that nothing had been broken and everything appeared to be in the same position and condition as at the time of starting on the trip."

"1. A total of 39 miles was covered on the following types of roads:

Dirt, rough, 14 miles.
Macadam, crowned, 22 miles.
Concrete, smooth, 3 miles.

"2. During all operating the writer rode in the trailer and observed the equipment. Operation over all roads was at fairly high rates of speed (20 - 45 mph).

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"3. Comments: The equipment and supplies rode well over all types of terrain; no changes in installation are recommended."

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Appendix F

TEXT OF SECOND MEDICAL LABORATORY'S REPORT ON FIELD  
TEST OF TRAILER LABORATORY, DATED 16 OCTOBER 1941



"1. With reference to the W.D. Letter, Office of The Surgeon General, dated August 16, 1941, the following report of observations and suggestions concerning the mobile laboratory trailer operated by the Second Medical Laboratory at Lake Charles, Louisiana, during the Third Army Maneuvers, September 3, 1941 to September 30, 1941 is submitted."

"2. Laboratory work accomplished by the trailer Laboratory:

"A. Clinical Pathology;

Malaria examination (Blood spreads)..... 5  
Darkfield (for Treponema pallidum .....15  
Urethral Smears (for gonococci).....10

"B. Bacteriology;

Nasopharyngeal cultures (for meningococci.....88  
Feces for Typhoid-dysentery group  
(Bacteriological)..... 9  
Water analyses (Bacteriological).....72  
Rabbit inoculation (for typhoid  
agglutination Sera)..... 1

Grand total.....200

"3. Comments and conclusions:

"A. The Trailer itself;

(1) It is the consensus of opinion among our officer personnel that the trailer as now constructed is too bulky for the purpose contemplated; that is, mobile laboratory facilities for a Field Army.

(2) The ceiling appears too high accounting for its top-heavy appearance and increased bulk. The trail-

or's maneuverability is therefore limited to hard surfaced roads and parking areas, thereby defeating one of the prime purposes of a mobile laboratory trailer.

(3) The present windows are difficult to raise and are easily broken by road jarring. Neither windows nor door are provided with screening. It seems desirable to have these facilities particularly with the summer months.

(4) While stationary, the trailer exhibits considerable motion due to movement of personnel. This movement causes considerable interference, at times, with the microscopic work and use of the prescription balance.

(5) When the prime mover is attached to the trailer the front end of the trailer is slightly elevated.

(6) The trailer's tires as compared to these of the prime mover are a different size and no spare tires are carried.

(7) The air for the trailer is drawn out with an electric fan. It would be better to have the exhaust fan converted into an intake fan equipped with a dust filter for providing dust free air.

(8) There is no heating system provided for the unit in the cold weather.

**"B. Equipment:**

(1) So far as this limited observation permitted, it is believed that facilities for packing are adequate. However, suggested changes in the size and number of certain items of glassware would necessitate adjustments. There was inconsequential breakage enroute from Washington to Lake Charles and thence to Fort San Houston, Texas.

(2) It is felt that a certain amount of shelf space would be desirable while the unit is stationary. None is provided. Likewise, there is poor utilization of drawer and cabinet space.

(3) The laboratory is not equipped with fire extinguishers. This deficiency is serious as the steam pressure sterilizer is heated by a gasoline stove and all the bunsen burners are of the alcohol type. The hazards of fire consequently are very great.

(4) There is no facility for either draining or defrosting the refrigerator. The water (from the melting ice about the coils when the current is shut off) collects in the bottom of the box causing a very disagreeable state.

(5) There is no adequate heating unit provided for the heating of the hot air sterilizer. We found that the heating element of the standard Q.M.C.



kitchen unit type generated sufficient heat for dry air sterilization. The gasoline heating elements now present in the trailer are inadequate or totally non-functionable.

(6) There is at present included in the trailer laboratory two new binocular microscopes, one new binocular dissecting microscope, one new monocular microscope, and one field (folding) microscope. It is felt that, for the work done in this unit, this equipment is too elaborate and in excess of the actual needs. The prism arrangements in the binocular microscopes are delicate and the jarring incident to the movements of the trailer will cause the prisms to become disarranged.

(7) The present dark field equipment leaks light and gives unsatisfactory dark fields. The absence of a set screw makes it impossible to properly secure the dark field apparatus to the microscope proper.

"C. Laboratory supplies: Certain items of supply are in excess of the ordinary needs and other items are far too deficient. Specifically, the following are offered in brief:

- (1) There is a marked insufficiency of 10 c.c. pipettes which are necessary in water examinations and too many 1 c.c. pipettes.
- (2) There are too few fermentation (aeration) tubes for water examinations.
- (3) There is an excess of dropping bottles.
- (4) There is a marked deficiency in the present number (two) of one liter flasks, whereas there are too many smaller flasks, particularly 250 c.c. and smaller. The larger flasks are needed in the preparation of media.
- (5) The selection of dehydrated media is unsatisfactory in that certain items are in excess and others are insufficient. Furthermore, there is a total lack of differential sugars.
- (6) There is at present no agglutinating sera for spot diagnoses and culture confirmation.

#### "4. Recommendations:

A. The present trailer as a Mobile Unit of an Army Medical Laboratory;

- (1) That the ceiling of similar trailers be made about six inches lower than the present trailer. This would afford sufficient clearance for any average person and do away with a considerable amount of bulk.
- (2) That the windows of the "push-out" type be utilized, allowing greater ease of manipulation and equal ventilation. It would be desirable to have

the windows so made that they will be airtight when closed and the present exhaust fan converted into an intake fan with a dust filter for air-conditioning the laboratory. That the windows and door be screened.

(3) That the motion of the trailer incident to movement of the personnel be eliminated by the installation of a springlock mechanism which will be used when the trailer is in a stationary position.

(4) That the trailer be provided with the same sized tires as the prime mover or vice versa and that spare tires be carried with the trailer.

(5) That the trailer be provided with some heating mechanism for cold weather work.

(6) That shelf space be provided, and sinking dead spaces in the suggested shelving will prevent spilling of materials. Drawer and cabinet space is poorly utilized at present. Built-in spaces for microscopes could be provided beneath the present utility or book cabinet, leaving some of the resulting space beneath the work benches for the installation of a self-contained, electrically operated oven or, if adequately insulated, a gas-line operated oven. The "beer pump" could be removed and the space utilized for other purposes. The pressure of the running water would be attained by means of a suitable pump. The wall space in front of the present autoclave could be utilized for a peg board for drying of glassware. The present drawers are so constructed that during their opening, "shavings" are cut from their bottoms. If not corrected, this will in time cause the drawers to loosen. The use of steel bottoms and steel tracks will eliminate this defect.

(7) That the unit be equipped with two fire extinguishers.

(8) That some drainage facilities be incorporated into the refrigerator.

(9) That the two new binocular instruments and the one new binocular dissecting instrument be removed. In their stead, substitute one more monocular microscope.

(10) That the collar arrangement holding the dark field unit be equipped with a set screw or other appropriate arrangement to obviate this defect. If this is not possible, then a new dark field apparatus should be provided.

(11) That at least fifty to sixty 10 c.c. pipettes be included.

(12) That the number of fermentation (large aeration) tubes for water analyses be increased by 100 tubes.



(13) that the number of dropping staining bottles be decreased and other useful items of glassware such as volumetric flasks be substituted therefor.

(14) That at least six (6) large, one liter flasks be included in the trailer unit and the number of smaller flasks be reduced, particularly small flasks below the 250 c.c. capacity. These one liter flasks are particularly needed in the preparation of media and other materials in quantity.

(15) Large amounts of dehydrated Lactose Broth (DIFCO) are necessary to carry on any degree of water analysis. The present supply of such media is inadequate for this purpose. On the other hand, the amounts of certain other items of dehydrated media for example Bacto-Proteose are in excess. It is recommended that 2-3 pounds of DIFCO Lactose Broth be included as an item. It is further recommended that a sufficient quantity of differential sugars be added.

(16) That agglutinating sera for spot diagnoses and culture confirmation be included.

"B. Its use as a Stationary Laboratory Section;

(1) That the present trailer or its equivalent together with three other similar units be used to make up the Stationary or Base Section of the Army Medical Laboratory, instead of the present set-up whereby each trailer is used as one mobile section of the Army Laboratory. One trailer will be equipped for Bacteriology, one for Pathology and Chemistry, the third for Serology and Food Analyses and the fourth trailer equipped for dish-washing, preparation of media and supplies. All four trailers will act as one Base or Stationary Unit.

(2) That each of the Mobile Sections of the Army Medical Laboratory be equipped with one small house trailer type unit similar to that used by the United States Public Health Service to procure and test various water sample. (See PUBLIC HEALTH REPORTS Vol. 56, No. 15, April 11, 1941, pages 754-760 for detailed description). These house trailers are small, light, inexpensive, very mobile, and can operate closer to the front within the Corps and Division areas than the present large type trailer. These house trailers are well equipped with work benches, drawers, electrically operated incubators and laboratory supplies sufficient for six months work. Each completely equipped trailer cost the United States Public Health Service \$3,615.50.

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(3) That each of these trailers be hauled by a  $\frac{1}{2}$  ton cargo truck and that they be so equipped that they may operate independently of the Stationary Section for at least two weeks. The  $\frac{1}{2}$  ton cargo trucks can carry the personnel of the mobile section, can be utilized to replenish supplies from the Stationary Section while the house trailer is parked in the forward area performing its mission, to carry messages, reports and transport officers to various areas for sanitary surveys, water reconnaissances, thereby speeding up the laboratory service to a more efficient level.

"C. It has been suggested by Lt. Col. Harvey R. Livesay, MC, that the Stationary Laboratory Section be equipped with four mobile units constructed along the lines of the General Electric Corporation Century of Progress Unit. The four units thus constructed could be placed together and can be made into one large laboratory which can perform practically any test which it may be called upon to do. All the supplies and equipment would be carried in these trucks in drawers and cabinets ready for instant use.

"D. That whatever the decision made as to what type mobile unit to be furnished the Army Medical Laboratories, the equipment and supplies be not stored in chests or crates, but that ample space in the form of drawers and cabinets be utilized to the fullest extent for their transportation. This can not be too deeply emphasized, for by actual experience, it took five men a total of ten hours to pack and load the medical supplies of the Stationary Laboratory Section prior to one tactical move during the recent Third Army Maneuvers, whereas the Laboratory Trailer was ready to move within a few minutes after the order was received."



Appendix G

TEST OF FINAL TEST REPORT ON THE TRUCK, 2½ TON, LABORATORY,  
MEDICAL, ARMY, FOR PERIOD 13 FEBRUARY 1944 TO 15 MARCH 1944,  
INCLUSIVE

"Submitted herewith is the final test report on the Truck  
2½ Ton, Laboratory Medical, Army, for period 13 February  
1944 to 15 March 1944, inclusive:

"1. Personnel.

Consisted of one (1) Major, MC, four (4) laboratory  
technicians, one (1) truck driver, 2½ ton, qualified.

"2. Equipment, Glassware, Supplies, Reagents.

a. Items listed on Enclosure #1 and #2 of preliminary report  
are confirmed as being a necessary part of the equipment  
except for the following:

(1) <u>Items in Excess</u>	<u>Unit</u>	<u>Quantity Desired</u>
1K92060, Osgall, Bacto	¼ lb	None
20040, Bandage, gauze, rolled, 2 inch	1 doz	None
40562, Bottle, screw neck, 9 cc	ea	None
43800, Pipette, Volumetric, 25 cc	ea	None
44000, spoon metal	ctn	1
44710, Vial, 2 dram	ea	100

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(2) <u>Items Deficient</u>	<u>Unit</u>	<u>Quantity Desired</u>
10160, Acid, Hydrochloric	lb	1
10200, Acid, Nitric	lb	1
10340, Acid, Sulfuric	lb	1
13660, Potassium Hydroxide	$\frac{1}{2}$ lb	1
14490, Sodium Thiosulfate (to neutralize Chlorine in water analysis)	$\frac{1}{4}$ lb	1
43010, Jar, Coplin (For use with Giemsa stain)	ea	2
70620, Lamp desk, flexible arm (for use in Bacteriology)	ea	1

(3) <u>Items Deficient in Quantity</u>	<u>Unit</u>	<u>Quantity Desired</u>
44364, Test Tube Kahn	ea	250
44405, Test Tube Support Kahn	ea	8

b. In comparison with equipment ordinarily used in stationary laboratories, serviceability is satisfactory, except for Item 94320, Incubator, which requires considerable amount of observation to prevent temperature fluctuations.

c. The manner of packing allows safety in transport and the items are satisfactorily accessible for operation. At present, it takes 90 minutes to pack for moving and 2 hours to set up for operation.

d. We have made use of the vacuum principle on which the windshield wipers function. By connecting rubber tubing to the vacuum and a series of Vacoliter bottles to prevent Ether and other chemical solutions from being carried to the motor, an efficient suction apparatus for the cleaning of pipettes is obtainable. Use of such suction may possibly be of use in Surgical trucks to obtain blood transfusions more quickly, suctioning material from the chest or abdominal cavity, etc.

"3. Apparatus:

The apparatus provided is generally satisfactory with the following qualifications:



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a. Item N S 7 - Oven, hot air  $0^{\circ}\text{C}$  -  $180^{\circ}\text{C}$ , as noted in the preliminary report has too small a capacity for the amount of glassware to be dried and sterilized. A larger unit, if adopted would decrease the amount of work bench space available, would necessitate the elimination of one side wall rack; both factors making it more feasible to operate in a tent. The amount of heat radiated would be an additional factor to indicate operation in a tent as a more feasible procedure. The apparatus has been run approximately 200 hours.

b. Item N S 7 - Refrigerator electric, Gennet & Sons, Model 3 has some limitations:

- (1) The enamel outside finish has "scuffed" easily and in places the enamel has peeled off. This was probably the result of heat, humidity and/or other local factors.
- (2) The cold of the compartment is dependent on electric power, hence in hot climates, Unit, Power, electric would have to be operated 24 hours daily. The latter, we believe has functioned so well because it has been operated on an average of 12 hours per day with frequent rest periods. For this reason a kerosene operated refrigerator may be preferable.
- (3) The size and shape of the item for the purpose intended, i.e. storage of antigens, sera, and enrichment bacteriological media (40 plates) has been adequate. If an occasion demands the storage of whole blood for transfusion, as may occur if the unit was part of an Evacuation Hospital, the item would necessarily have to be larger.

c. Item 94320, Incubator, 1920 Model - The air-jacket type manufactured by the Precision Scientific Company and shipped from the Carlisle Medical School was received two weeks prior to this date. The item is too small for use since only a total of 30 culture plates of 15 water analyses tests can be accommodated. The maintenance of a uniform temperature, however was as constant with this air-jacket type as the water-jacket type which we have used since the start of the testing program. Both, however, require frequent observations especially during the night, to prevent fluctuations of the temperature as a result of outside and inside temperature changes. An air jacket type of the height (36 inches, including thermometer level) and volume (90-100 culture plates) of water-jacket type would be equally suitable for use. In either instance permanent fixation during movement is desirable; likewise, fixation in the center of the work bench on the left necessitates division in the center of the overhead rack and each half placed adjacent to the incubator.

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d. Item 94010, Autoclave, Laboratory Field - Because of its size and amount of radiating heat, the apparatus is operated best in the laboratory tent. Forty runs totaling 50 hours were made.

e. N S Item 9 Autoclave, small (aluminum cooker).

(1) This item was received 10 days prior to this date. Eight runs totaling 5 hours time were made.

(2) The advantages of this instrument over 94010 are as follows:

- a. It is lighter (less than 25 pounds) and consequently easier to handle.
- b. It can be operated over an open fire.
- c. Complete autoclaving is accomplished in 30 minutes while with item 94010, 50 - 70 minutes is necessary depending on the external temperature.

(3) The disadvantages are:

- a. There is a leakage of steam from the steam joint, the escape valve, and the safety valve, when a pressure of 10 to 30 lbs is obtained. Hence, constant pressure could be maintained only by removing the source of the heat thus necessitating constant supervision. Item 94010 has a regulated automatic safety valve, there is no steam leakage, and after reaching the desired pressure need not be supervised.
- b. Its total capacity limits the amount of material one may autoclave which is not true of item 94010.

(4) We conclude that the Aluminum Cooker is a useful adjunct, especially if Coleman burners are not functioning properly, but should not replace item 94010.

f. Coleman Burners - Model 522 (10,000 BTU) - This item heats our hot water tank and item 94010 autoclave. No extra generators (vaporizers) accompany these burners and none are stocked at the local Medical Depots. Since their proper function and length of service varies directly with the quality of the white gas used (we have found the quality quite variable) extra generators should accompany the truck.

g. We have found the following items to be very satisfactory and necessary:

(1) 99555, stove, two burner, gasoline (extra generators



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- 5,000 BTU, are supplied).
- (2) NS 4, Water bath.
  - (3) 41390, centrifuge, electric, small.

h. Item 94070, burner, gasoline blast could not be made to function successfully.

"4. Laboratory Tests.

a. Enclosure #1 lists the type of tests which were available and the number of actual tests performed. The source of our material was a Provisional Evacuation Hospital supporting two to three divisions, numerous Corps and Army Units.

b. The season of the year dictated the type of laboratory requests yet trial runs of other tests not requested were performed in an effort to more fully estimate the efficiency of the truck.

c. The following technical observations are noted:

(1) Bacteriology.

- (a) Except in the case of media which may be tubed and then autoclaves, considerable difficulty in preparing uncontaminated media was noted.

This applies mainly to enrichment medias such as blood and chocolate agar while 55 Agar gave us no difficulties. The problem is not impossible because by observation of good technique followed by immediate refrigeration, our media would remain sterile 3 - 4 days.

- (b) because of the tendency for the incubator temperature to fluctuate, due to external temperature changes, technicians must continually note the temperature readings. The fluctuations noted during our testing made the culture of the gonococcus difficult. The above two factors do not appreciably affect stool bacteriology which will constitute most of our work.

- (2) Hematology -- Although Hemoglobin requests were infrequent, nevertheless, Item 42840 is inaccurate and should be replaced by a suitable Hemo-globinometer.

d. In addition to the tests recorded, bacteriological studies of old latrines, and coliform indices of local water points were conducted.

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"5. Adaptability of Truck as Vehicle for a Laboratory.

a. Frequent movements during the six weeks of maneuver activities has proven that equipment damage is negligible. Item 99600, Unit Power, Electric should however, be transported in a suitable carrying case.

b. Maneuverability is excellent as noted during this period of testing.

c. A tent is necessary to supplement the truck for the collecting and recording of specimens, autoclaving and possible sterilizing of equipment. For convenience of operation, protection against inclement weather, and blackout conditions, it would be most suitable to use a surgical operating tent of the type used in Armored Divisions so that direct attachment to the rear of the truck would be possible.

d. The water tank is filled from the roof at present by passing 5 gallon cans to a man on the roof. This is necessary because the water hose leading from the water trailer is too short. It is recommended that 25 feet of hose accompany the truck for the purpose of filling the water tank. To reach the roof, it is necessary to step on the canvas hood protecting the front seats. It may be desirable to have this roof over the seats made of steel because of the wear involved in filling the tank.

"6. Adaptability of Truck Body as Working Area.

a. For the size of the truck and its design, head room and aisle space is adequate. The space available accomodates two technicians and one assistant (glassware) without confusion.

b. A few of the facilities are unsatisfactory from an operational standpoint. The following are recommended changes:

- (1) Division of the present sink into two compartments with separate drains to facilitate proper cleaning of the glassware.
- (2) The end of the drainage pipe should extend over open space to permit drainage directly into a soakage pit. The present arrangement won't allow such; instead wastes now drain onto the undercarriage parts.
- (3) Considerable difficulty in the preparation of bacteriological media in petri dishes is encountered when the truck is not parked on a level area. It may therefore be desirable to use blocks, and a jack to level the truck.



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- (4) The racks located on both sides of the truck are unsatisfactory. It is recommended that an enclosed shelf of similar size and length be substituted.
- (5) The drawer latches are unsatisfactory. It is suggested that a single iron bar, extending through the drawer handle spaces, from floor to work bench be substituted.
- (6) (a) The drawer with partitions for holding petri dishes in vertical position is highly unsatisfactory because:
1. In movement, the solid media is loosened from its base and slips into the lower edge.
  2. Water of condensation collects at the lower edge and on righting the plate, the water runs over the media to promote the growth of "spreading" rather than "discreet" colonies of bacteria.
- (b) It is suggested that a similarly partitioned rack with door, holding the petri dishes in a horizontal position, be placed on the right side of the wall, over the work bench and near the exit.
- (7) To prevent unnecessary opening of the doors with resultant drafts (affects incubator temperature) and entrances of contaminated dust (contaminates media) it is suggested that a sliding port be made for the exchange of reports and specimens.

c. Ventilation is fairly adequate, depending on the following factors:

- (1) 1900 to 0700 (Lights and Incubator in use - doors and windows closed).

OUTSIDE

INSIDE

65° F

78° F

41° F

65° F

30° F

59° F

If the interior temperature falls below 65° F, the Evans air Heater must be used to maintain a normal incubator temperature, i.e. above 35° C.

- (2) 0700 - 1900 (Hot Air Oven - Stove burner, incubator, water bath lights in use).

- (a) Without circulating fan - doors and windows closed.

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OUTSIDE

INSIDE

35° F

68° F

64° F

82° F

66° F

90° F

- (b) With the doors open and the outside temperature 64° F the inside temperature is 76° F.
- (c) With the circulating fan in use the temperature is lowered 4 - 6° F.
- (d) With the doors and windows open and the outside temperature 64° F, the inside temperature is 68° F.
- (3) If the amount of bacteriology to be done is great, the windows and doors must remain closed because of the danger of contaminating culture media. The time necessary to keep such ports closed would not be more than two hours at any one time, hence the working conditions of the personnel would not be appreciably affected.
- (4) During the present testing, temperatures between 35° and 75° F only have been encountered. We may assuredly state that working quarters would be satisfactory at outside temperatures of 30 - 80° F. We may state that they probably would be satisfactory at 0°. Further testing would be necessary to determine the same if the outside temperature was above 100°.
- (5) No obnoxious fumes exist to affect the personnel.

"7. General Information.

From our experience with this mobile laboratory as well as other mobile units of an Army Medical Laboratory, we envision the present unit functioning best as a Bacteriological and Serological Laboratory attached to an Evacuation Hospital. During epidemics it could function unattached for as long as ten days to two weeks, without additional supplies depending on the volume of work. In the case of an outbreak of dysentery, the unit would be adequate to perform the necessary laboratory work for 100 cases. Again, depending on the volume of work, this unit could function as a 250 bed hospital laboratory except that no biological chemistry could be performed. We do not feel the unit is adequate to function as a central laboratory for a group of small hospitals. The only conditions under which this unit would be considered of less value than similar equipment packed in chests, would be in jungle areas. If the unit was to act as a small laboratory for three to four weeks, additional transportation would be needed for carrying the personnel and to secure supplies."



Appendix H

TEXT OF SERVICE TEST REPORT ON MOBILE DENTAL LABORATORY  
FROM 16 MAY 1943 TO 19 JUNE 1943, PREPARED BY FIRST  
CONVALESCENT HOSPITAL, SECOND ARMY

"1. In compliance with letter, Headquarters, Second Army, Surg. 319.1 (D) (1st Conv Hosp) and in accordance with letter SGO, subject: Mobile Dental Laboratory, February 12, 1943, the following report is submitted.

"2. During the test, the laboratory functioned from May 16, 1943 to June 19, 1943, under actual field conditions, in the Tennessee Maneuver Area. The Laboratory operated at Dispensary, Maneuver Director Headquarters for ten (10) days; at Co "D", 304th Medical Battalion, 79th Infantry Division for seven (7) days; at Clearing Station, VII Corps for three (3) days; at Co "D", 306th Medical Battalion, 81st Infantry Division, for ten (10) days, part of which time the Laboratory operated under blackout conditions. There was completed during this time, thirty-five (35) full dentures, one hundred fourteen (114) partial dentures, and thirteen (13) repair cases.

"3. The pilot Model of the Mobile Dental Laboratory can function very satisfactorily as originally equipped, but there were not enough expendable items included to operate more than a few days without replenishing the stock. It is believed, however, that the suggested changes and additions recommended below, will greatly increase the full operating efficiency of the laboratory.

"4. Recommend the addition of features, in present design of interior of laboratory, as follows:

"a. The addition of two (2) shallow drawers, 12" x 18" x 3",

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under work bench on left side of laboratory for small hand instruments.

"b. The addition of two (2) shelves, for cases being worked on:

- (1) One left side wall of laboratory, above windows approximate size 7'6" x 6".
- (2) One on right side wall above rear window, approximate size 3'5" x 6".

"c. The addition of an exhaust fan above filing cabinet on left side of laboratory, at rear, for expelling fumes from lamps, when laboratory is closed and operating in blackout.

"5. Recommend changes in features of interior of laboratory as follows:

"a. That work benches on both sides of laboratory be reduced from 23 $\frac{1}{2}$ " to 18 $\frac{1}{2}$ " in width. The reduction of 5" will not reduce working area of bench below needed requirements, but will increase free space between benches thus allowing free movement from front to back without interfering with workers at bench.

"b. That the water level gauge now in center of water tank about head height and directly over outer edge of sink be moved to the right over work bench, thus preventing persons using sink from striking their heads on the gauge.

"c. The changing of the drainage from sink by placing an elbow on the terminal end of the drain pipe to throw the water towards center of truck and away from muffler. At present, water drains directly on muffler and will cause it to rust out if not corrected.

"6. Recommendations as to addition and deletion of equipment and supplies believed necessary for operation of Mobile Dental Laboratory as follows:

"a. That no items be deleted from present "Packing List".

"b. That items listed on Inclosure No. 1 be added to present "Packing List".

"c. That changes in amounts of expendable and nonexpendable supplies listed in Inclosure No. 2 be incorporated into present "Packing List".

"d. That list of equipment and supplies, Inclosure No. 3 be used in supplying the Mobile Dental Laboratory.



"7. Report on efficiency of Fixed Installations of Mobile Dental Laboratory.

"a. Laboratory mounted on a GMC, 2 $\frac{1}{2}$  ton, 6 x 6, 4D.T. truck chassis which operating under actual field conditions, has proven to be very satisfactory.

"b. Hot water system.

- (1) Hot water heater, located right front of truck, works with complete efficiency if white gasoline can be obtained and used.
- (2) Hot water storage tank, 10 gallon, located inside Laboratory on right anterior wall is adequate.

"c. Laboratory Heater.

- (1) Evanair Vehicle Heater, located left front of truck works very efficiently if white gasoline is used.
- (2) An electric circulating fan for heater, located inside laboratory in the left anterior wall has proven satisfactory.

"d. Cold water system.

- (1) Supply tank, located across anterior wall of laboratory has a capacity of 60 gallon, which is adequate under present field conditions, for about one (1) day. (See Paragraph 5 b, re change in location of gauge)

"e. Electrical system.

- (1) Intake supply.
  - (a) Power line, if available very satisfactory.
  - (b) Onan Electric Field Plant (AC, 115 V, 1500W) very satisfactory...
- (2) Outlets in laboratory consist of seven (7) double outlet plugs well placed and adequate.
- (3) Illumination in laboratory.
  - (a) Six 6" ceiling lamps, two of which receive power from truck battery very satisfactory.
  - (b) Four flexible arm lamps well placed and adequate.
- (4) Dental engine, Weber desk type, well placed, satisfactory.
- (5) Electric boil-out and processing unit, consisting of two (2) hot plates and two (2) processing pots inclosed in covered well in left work bench proven satisfactory but are slow in heating up. Requires about two (2) hours to bring water to a boil. It is believed that the raised letters on bottom of

the two processing pots prevents full contact with surface of hot plates and thus reduces transmission of heat to pots. Also recommend the placing of a small groove  $\frac{1}{4}$ " from periphery of processing pots, around the inclosed top of well to prevent water, from running down into hot plates.

"f. Supply Storage Space.

(1) Bench Drawers:

- (a) Five 23" x 24" x 8" sufficient and well placed.
- (b) Five 18" x 35 $\frac{1}{2}$ " x 4 $\frac{1}{2}$ " sufficient and well placed.
- (c) Eight 23" x 18" x 6" sufficient and well placed.

(2) Closet beneath sink, 3 shelved, 4' x 3 $\frac{1}{2}$ ' x 2 $\frac{1}{2}$ ', is quite adequate for larger supplies.

(3) Filing cabinets, located at right and left rear of laboratory is quite adequate for records, gowns and small supplies, contains following:

- (a) Sixteen 23" x 9" x 6"
- (b) Two 23" x 9" x 4"
- (c) Two 5' x 1' x 18"

"g. Miscellaneous.

(1) Acetylene tanks.

- (a) Two 250 lbs tanks are adequate if used only for casting, soldering and vulcanizing.
- (b) No pressure regulator received with acetylene tanks. This regulator quite vital for efficient operation.

(2) Plaster bin divided into four compartments:

- (a) Two for plaster paris. Sufficient.
- (b) One for artificial stone. Sufficient.
- (c) One for investment. Sufficient.

(3) Sink.

- (a) Porcelain sink with hot and cold water faucets, satisfactory.

(4) Work benches, except for changes recommended in paragraph 5 a, very satisfactory.

(5) Windows, four (4), complete with blackout curtains, very satisfactory.

(6) Recommend that linoleum on floor of laboratory be cemented to prevent its warping and cracking."



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Appendix I

TEXT OF LETTER CONTAINING INSTRUCTIONS GOVERNING CAPTAIN  
MANGOLD'S TESTING OF PILOT MODEL TRUCK, 2½-TON, 6X6, OPTICAL  
REPAIR UNIT

27 November 1943

Subject: Operational Test of Mobile Optical Repair Unit as  
Developed by Carlisle Barracks.

To: -The Commanding General  
Carlisle Barracks, Pennsylvania  
Attention: Col. E. D. Quinnell, Director,  
Medical Dept. Equipment Laboratory.

1. The new inclosed type Mobile Optical Repair Unit as developed by your office was demonstrated to the members of the Optical Advisory Board, and was accepted with considerable enthusiasm by all of the members of said board. It was the consensus of opinion of the Board that since practically the same equipment was being included that had been previously used in other mobile units, a lengthy field operational test would not be required. However, a limited operational test should be made in order that any minor deficiencies might be corrected before final specifications are written.

2. Therefore, in accordance with the decision of this Board authorizing such a test, arrangements will be completed by this office whereby Captain A. E. Mangold, Sanitary Corps, who has had actual overseas experience in the operation of such units, will be made available to conduct the operational test under the supervision of your office. In addition, six

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enlisted men who have recently completed the training course for opticians at the Medical Supply Services School, St. Louis, Missouri, will be transferred to Carlisle Barracks for this temporary duty. The orders for Captain Mangold and the above enlisted men will provide for their arriving at Carlisle Barracks in sufficient time to start the operational test 30 November 1943, and such orders will be for a period of approximately ten days. It is recommended that these operational tests be made over a consecutive period of approximately seven days.

3. The following is set out as a guide in the operational test during this period.

a. Purpose - To determine practicability of completed unit as pertains to equipment and location within the unit, in relation to productive capacity obtainable in actual field operation.

(1) On basis of stationary operation.

- (a) Using regular electrical current (available at location)
- (b) With use of generator.

(2) On basis of mobile run under field conditions. (It is recommended that this incorporate movement to certain field installations setting up unit to operate and actually performing prescription service - no doubt the several points located near Carlisle Barracks as discussed with you, can be included on this run.)

b. Points to be covered and decision made based on result of these tests:

- (1) Total daily productive capacity of unit. \_\_\_\_\_
- (2) Number of men required to man unit. \_\_\_\_\_
  - (a) To reach maximum capacity of unit. \_\_\_\_\_
  - (b) The maximum number of personnel required for efficient operation of the unit arriving at average maximum capacity.
- (3) Determine excess equipment to carry with unit as emergency replacement factor.
- (4) Determine if additional equipment required,



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such as tent, flashlights, towels, soap, miscellaneous, etc.

(5) Determine additional conveyances required to carry personnel and their baggage, tent, (if required) generator, etc.

(6) Determine size generator required to operate the unit.

(7) Determine if heating and hot water supply is sufficient.

(8) Determine if unit can be properly operated under blackout conditions (with and without tent).

(9) Determine the feasibility of making special space available to carry surfacing lags, equipment, tools, etc., so that all metal cabinet space can be utilized for stock and supplies, also giving proper consideration to reserve drawer space that should be carried for emergency additions of supplies.

(10) Determine whether or not any of the present quantities of original stock of supplies as furnished are excessive.

(11) Determine if present stocks should be supplemented with additional quantities of certain items to insure maximum utilization of carrying capacity of such unit and giving proper consideration of reserve cabinet drawer space required (paragraph 9).

(12) Determine proper protection screens for windows as guards against bomb fragments, etc.

c. Equipment and proper placement within unit.

d. Stock and supplies (based on quantities to be carried, the location and distribution of such stock within unit as pertains to cabinet drawers properly marked, etc.

4. It is requested that when the operational test has been completed, determination be made of the additional

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supplies that will be required to properly stock this unit in accordance with the maximum stocks that will be carried as set out above. Such quantities will be requisitioned from this office and will be shipped for inclusion with this unit so that "Pilot Model" will then be complete as to equipment and stock for the purpose of using as a basis of procurement on quantities required, in accordance with completed tentative specifications.

5. It is anticipated that due to the limited production facilities that are available, that it may be necessary to grant certain concessions to the manufacturers to insure expeditious delivery of completed Mobile Optical Units constructed in accordance with the specifications written on the Pilot Model. To give these suppliers an opportunity of making any recommendations that would aid in the overall procurement objective, it is requested that at some time during the operational test, or before the final specifications are written, this office be advised so that arrangements can be completed with the supplier for one of their engineers to make inspection of such unit. Your cooperation in this connection will aid in elimination of delivery delays of completed units from suppliers on an item which is urgently needed for overseas theaters of operation.

6. Captain Mangold has, in view of his broad optical experience as pertains to operation of mobile units overseas, proved a very valuable aid to this office through recommendations made for improvement of the overall optical program. It is therefore, requested that your office give every consideration to any recommended changes he might make as result of this operational test, as it is believed that this will result in the final approved Pilot Model meeting all the requirements that will be necessary under actual field operating conditions.

7. In the event this office can be of any aid during this operational test, please do not hesitate to call on us.

By order of The Surgeon General:

JOHN B. KLOPP,  
Lt. Colonel, Medical Corps,  
Chief, Field Equipment Development Branch.

CONCURRENCE:

PAUL I. ROBINSON,  
Colonel, Medical Corps,  
Director, Supply Planning Division.

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Appendix J

COPY OF CAPTAIN MANGOLD'S REPORT ON OPERATIONAL TESTING OF  
TRUCK, 2½-TON, 6 X 6, OPTICAL REPAIR UNIT

AEM/eh

CARLISLE BARRACKS

MEDICAL DEPARTMENT EQUIPMENT LABORATORY  
UNITED STATES ARMY

In Reply Refere To: Carlisle Barracks, Pa.,  
8 December 1943

SUBJECT: Operational Test of the Mobile Optical Repair Unit  
developed by the Medical Department Equipment  
Laboratory.

TO : Colonel Paul I. Robinson, M. C., Director, Supply  
and Planning Division, Office of The Surgeon  
General, 1818 H. Street, N.W., Washington, 25,  
D. C. Attention: Captain K. A. Short.

1. The new inclosed type Mobile Optical Repair Unit  
was given a limited operational test by Captain A. E.  
Mangold and six enlisted men.
2. Length of test was for one week, not consecutive  
days, due to difficulties listed in this report.
3. In answer to the guide request by your office the  
following is reported:

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a. It was found that the unit, operated in a warehouse using electric means, was satisfactory in all respects. For the use of the generator a 2-1/2 KVA gasoline motor generator was used. A test run was made in the field and it was found that five minutes were required to set up the optical equipment for operation and 15 minutes were required to service and start operation of the generator.

b. In answer to the following, points were covered and a decision made as follows:

- (1) Total daily productive capacity of the unit -- 75 jobs.
- (2) Number of men required to man unit -- 6 men.
  - (a) To reach maximum capacity of unit -- 6 men.
  - (b) Maximum number of personnel required for service operation of the unit to arrive at average maximum capacity -- 6 men (one driver).
- (3) Excess equipment -- 1 cutter.
- (4) See additional list. (Letter to S.G.O. 8 December 1943).
- (5) Additional conveyance -- 1 staff car.
- (6) Size generator -- 2-1/2 KVA.
- (7) Heating and Hot Water -- Sufficient and adequate.
- (8) Operating under Blackout -- A piece of canvas tent fly or tarpaulin drawn from the Quartermaster or Ordnance to act as light trap.
- (9) Arranging special space for equipment, etc. -- Alterations are being made by the Equipment Laboratory which will be incorporated in the final specifications and drawings.
- (10) Excess materials and supplies, such as polishing pads, blacking pitch, Calipers, pads, cement, files, reject lenses, pliers,



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etc. -- corrections made in new specifications.

(11) Supplementing present stocks -- See separate list.

(12) Protection for windows -- Equipment Laboratory reports this is not feasible

c. Placing of equipment within unit -- Changes made in final specifications and drawings.

d. Location and distribution of materials -- See blueprint for suggested stock arrangement.

4. See Final Specifications.

5. Medical Department Equipment Laboratory reports that they will be happy to cooperate with manufacturers or suppliers.

6. Captain Mangold was given complete cooperation by the Medical Department Equipment Laboratory while testing this unit. The following is suggested:

a. All Optical Equipment after being installed in in truck should be run for twelve consecutive hours to make sure that mechanically they are in good working order.

b. Cutting wheels or diamonds for cutter should be checked carefully to make sure that they are efficient.

c. Edging stones should have a metal cover to protect them in transit.

d. An attachment should be made to hold head of M840 away from stone while truck is in transit

e. A test of a blue edging stone should be made at the factory to ascertain whether or not it would be feasible to include one of these in the unit.

/s/ Aurel E. Mangold  
/t/ Aurel E. Mangold  
Captain, Sanitary Corps

1. The first of these is the fact that the

2. The second is the fact that the

3. The third is the fact that the

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Appendix K

COPY OF REPORT OF INSPECTION OF TRUCKS MADE AT ARMY MEDICAL  
PURCHASING OFFICE BY REPRESENTATIVE OF MEDICAL DEPARTMENT  
EQUIPMENT LABORATORY

WBC/mb

ARMY SERVICE FORCES  
MEDICAL DEPARTMENT EQUIPMENT LABORATORY  
CARLISLE BARRACKS, PA.

SPMES 451.2/2500

Project F 32

In Reply Refere To:

6 January 1945

SUBJECT: Inspection of Truck, 2½ Ton, 6x6, Optical Repair  
Unit.

TO: The Surgeon General, U. S. Army, Washington 25,  
D. C. Attention: Director, Technical Division.  
(Thru: The Commanding General, Carlisle Barracks,  
Penna.).

1. At the request of Lt. Col. Howard F. Baer,  
Director, Materiel Standards Division, Army Medical  
Purchasing Office, New York, N. Y., an officer from the  
Equipment Laboratory was sent to New York to examine a pro-  
duction model Truck, 2½-Ton, 6x6, Optical Repair Unit with  
particular reference to certain changes in the truck interior  
equipment which were accepted by the Optical Branch of the  
Army Medical Purchasing Office, New York, and which were at  
variance with the applicable Medical Department Equipment  
Laboratory Drawings.

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2. The changes found by the Laboratory Officer are as follows:

a. The truck was not one made under the Basic Truck contract as the black-out shades were surface mounted and interfered with the cabinets being placed in their proper position. By moving the rear shades slightly forward, the cabinets were placed as close as possible to the required position.

b. Vertical Storage Compartment doors have been cut into two sections and a removable shelf has been placed in the cabinet. The M.D.E.L. drawing shows a single door and no shelf.

c. The Table Top has been made of plywood covered with a hard pressed structural fiber-board sheet, and has a front working edge made of oak. The table top is painted with a clear resin paint. The M.D.E.L. drawing calls for an acid-proof finish on the table and has no separate front edge specified.

d. Holes approximately 1/4 inch diameter have been drilled in the lower end of the cabinet locking bars for the insertion of keys or pins to prevent the jumping out of the locking bar. M.D.E.L. drawings do not show the hole mentioned.

e. The two, rear, flush, electric, receptacles on the left side of the vehicle have been covered by a cabinet 44 inches wide which made it necessary to place exterior wire molding with two surface type receptacle boxes over the rear left window. The wiring to the surface receptacle was run from the left, rear, flush, receptacle. The M.D.E.L. drawings show the flush receptacles as being 41 inches apart and the cabinet 38 inches wide. The dimensions shown in the M.D.E.L. drawings would permit the cabinet to fit in between the flush receptacles and the additional surface wiring would not be required.

f. Lens Surfer has been reversed to have the handle to left of bowl. Handle shown to right on M.D.E.L. drawing.

g. Cutters have been removed from the sink cabinet at the front left of truck as shown in M.D.E.L. drawings and stored, one in a box fastened to the wall of the truck and one with other material in a general storage box.

h. Hot water tank has been moved to a new position and counter-sunk into the sink cabinet top. The hot water tank was too high to fit under the cold water supply



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tank and was moved toward the center of the truck to leave room for the "Edger" motor. The M.D.E.L. drawing shows the hot water tank against the front and right side wall of the truck.

i. Axis Marker and Lensometer have been reversed to opposite sides of truck.

j. Certain drawers and inserts have had dimensions changed to make drawers larger or to fit new equipment.

k. Footman Loops have been mounted on the floor instead of the wall as shown on the M.D.E.L. drawing.

l. Edgers have the switches mounted under the table top lip instead of on the motor housing as shown on M.D.E.L. drawing.

m. Auxiliary piping arrangement has had the pipe mounted with collars to fit over studs on the "Edger" housings. M.D.E.L. drawings show the pipe fastened to the housing with self tapping screws.

n. Sink drain pipe has been turned to drain toward the front of the truck running through the floor between the cabinets. The M.D.E.L. drawing shows the drain turned to the left side of the truck and the cabinets close together.

o. Metal channel and angle sections have been added to the cabinets under the sink to permit easier removal for opening into the storage space to the right of the cabinet.

3. Additions added to the interior equipment of the truck consisted of two drawers in the sink cabinet, bolt and block for securing the lens surfer bowl, box for storage of lens cutter and a fitted box for general storage.

4. As the Medical Department Equipment Laboratory Drawings applicable to the Truck, 2½ Ton, 6x6, Optical Repair Unit have been standardized as now drawn, disposition of this project is requested.

E. D. Quinnell  
Colonel, Medical Corps  
Director

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Appendix L

TEXT OF LETTER IN WHICH CAPTAIN MANGOLD JUSTIFIED AS DESIRABLE CERTAIN DEPARTURES FROM APPLICABLE SPECIFICATIONS ACCEPTED BY ARMY MEDICAL PURCHASING OFFICE IN THE TRUCK, 2½-TON, 6x6, OPTICAL REPAIR UNIT

1. Reference is made to Project F-32 and communication of 6 January 1945 from Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania.

2. Inclosed herewith are blueprints 100,068 and 100,098 from Krieger Steel Sections, Inc., 1111, 34th Avenue, Long Island City, New York, showing the changes (circled in red pencil) that are to be made in the basic truck.

3. Reference is made to the communication from Medical Department Equipment Laboratory, Carlisle Barracks, Pennsylvania dated 6 January 1945, changes noted as follows:

a. Due to the new construction in the basic truck, this change noted in communication will not be necessary.

b. This change will allow separation of various types of working materials.

c. This change is to be made so that opticians may use table tops in edging more efficiently in their optical work.

d. This change is to be made so as locking bar will not work out when truck is driven. Note: See letter from this office dated 1 March 1945, Subject: Stock No. 9958900, Truck, Optical Repair Unit, and Yawman and Erbe Drawings 246 and 247 attached therewith.

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e. As this change was made to enable us to use cabinets that had already been delivered, this alteration was necessary. It is requested that new blueprints be made for a cabinet which will fit between the two outlets which will eliminate any change in basic body. See Medical Department Equipment Laboratory Drawing C539.

f. This change should be made so that handle of surfacer is in correct working position.

g. This change should be made for more efficient operation of optical equipment.

h. This change should be made to allow edger motor to fit between water tank and truck wall enabling us to use the space for edger motor. See Krieger Steel blueprints 100,068, Section AA and 100,098.

i. This change should be made for the more efficient operation of the optical equipment.

j. This change should be made so that special optical equipment will fit in drawers.

k. This change should be made so that stools remain in position when truck is being driven.

l. This change should be made for the more efficient operation of optical equipment.

m. This change should be made for the more efficient operation of optical equipment.

n. This change should be made to allow working space on front table.

o. This change should be made to allow for easy removal of front cabinet.

4. Additions that were added to the interior of the truck are necessary for more efficient operation of unit as a whole.

5. It is suggested that before the new blueprints of basic truck and equipment for the mobile optical repair unit be standardized that this office have the opportunity of checking them.



Appendix M

COPY OF REPORT WITH LISTS OF RECOMMENDED EQUIPMENT SUBMITTED  
22 OCTOBER 1943 BY LIEUTENANT COLONEL DONALD McNEIL, M.C.,  
AND SECOND LIEUTENANT MARGARET E. GAYNOR, A.N.C., RELATIVE TO  
EXPERIMENTAL PACKING OF SURGICAL OPERATING TRUCK

F-35

22 October 1943

SUBJECT: Surgical Truck, Operating.

TO: Director, Medical Department Equipment Laboratory,  
Carlisle Barracks, Pa.

1. Surgical packs for surgical unit.

a. Surgical packs were made by Lieutenant Gaynor, ANC, as requested and furnished for samples. These packs consisted of Major and Minor packs as per attached list (see Inclosure 1).

b. Major packs are not intended for use in every operation as it is conceivable that the operators may go from one case to the next simply by rinsing or changing their gloves using the same gowns.

If it is necessary to change drapes, these can be taken from a Minor pack without contaminating other gowns or breaking open a Major pack. This is done by using the original sheet wrapper of the Major pack which is already on the instrument table and covering the table with one towel; two may be necessary. This renders the table relatively sterile. The Minor pack may then be opened, its contents

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placed on the table and the next case prepared. Extra sterile gowns or dressings are available from sterilized drums without opening Major or Minor packs.

c. Towels. Eight towels were put in the packs so three persons scrubbed could each use one to dry their hands before donning gloves. These three used towels with one more towel can be used for draping the operative field which later will be covered by two sterile sheets. One towel goes on the adjustable instrument table which is first covered with a sterile pillow case. The three remaining towels are then used as the occasion demands.

d. Sheets. Sheets are fan folded in order to permit easy and fast draping without contamination. Each sheet is first placed at the site of operation and then opened distally.

e. Tape sponges. Due to the probable shortage of sponges moistened abdominal tape sponges may be used for sponging during operation. If necessary they can be rinsed in sterile water and wrung out. Six tape sponges were included; these may be washed subsequent to operation, sterilized and reused.

f. Dressings. The dressings included in each Major and Minor pack are in our opinion the minimum. It is felt that these may have to be augmented by extra dressings from sterilizer drums, however, every effort should be made to conserve their use and the abdominal tapes should be substituted for sponging whenever possible.

f. Outside wrappers of Major and Minor packs. One hundred and fifty (150) yards of muslin were included. This amount is only necessary in equipping the truck initially as this muslin is used for wrapping packs, basins, pitchers, gowns, dressings and other sterile supplies. When the contents of such packages are exhausted these covers may be employed similarly many times.

2. Review of equipment of surgical unit with suggested additions and deletions.

a. A separate list has been prepared (see Inclosure 2) showing the additions and deletions from the original list presented. These proposed changes with the original list, we feel, will give a basic supply of sterile goods and instruments which can be varied depending on the nature of the work the unit may be called upon to do.

(1) Stockinet. Stockinet cut on the bias, divided into 5-yard lengths and rolled makes an excellent



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compression bandage. The six-inch size is used for the extremities; the nine-inch for the thorax or abdomen. In our experience this bandage has proved so useful that we think it should be included here. The bandage may be sterile or unsterile as the occasion demands.

(2) Basins and pitchers. Basins and pitchers were wrapped in sets to conserve space. The addition to the previous list of pitchers allows two sterile and two unsterile as they have many uses.

(3) Vaseline gauze. Continuous vaseline gauze in two-inch widths should be prepared and kept sterile preferably in unbreakable containers. This can be made from materials already included.

(4) Instruments.

(a) Two basic instrument sets would seem sufficient for only one team. We believe two teams should have three sets so one may be sterilized while the others are in use. This, of course, implies sterilization by boiling for conservation of time.

(b) The Genito urinary injuries, Supplementary Instrument Set, has been added as it takes little room and most of the items in the set will be needed.

(c) One Amputations and Fractures, Supplementary Instrument Set 1942, is already on the list. If the purpose of this surgical unit is abdominal work, this is enough. Should the unit, however, be called upon to take care of general casualties, at least another set should be added. For such general work, in addition, there should be added the Extension Apparatus, Kirschner and Extension Apparatus Steinman, with at least twelve (12) Steinman pins; each in 5, 6-1/2 and 8-inch sizes. In that case also larger quantities of plaster, splints, sheet wadding, and felt would have to be added, and also a small portable fracture table.

(d) For units handling compound fractures, a few Roger Anderson pins with the external fixation bars would be of great value in cases where for one reason or another plaster fixation was thought inadvisable. We do not feel that valuable time should be spent in obtaining accurate reduction, but in certain cases there is no quicker way in which to obtain immobilization and still have easy access to the wound than by the use of these pins.

(e) Sharps and needles should be kept in cresol solution, full strength when the truck is stationary.

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(f) Sutures in tubes might either be boiled or kept in alcohol depending on the urgency of their need. Silk, cotton and dermal can be boiled.

3. Possibility of use of surgical unit with surgical teams and evacuation hospitals.

a. In general the impression gained from the surgical truck and tent is that it is the best thing of its kind that we have seen to date. The idea of the truck being able to move and leave the operating tent standing is very good. The possibility of having to move suddenly and leave the tent but still carry away most of the equipment is also very appealing. From previous experience we have found that an inner lining in an operating tent keeps the dust nuisance to a minimum and also makes a difference in temperatures in hot climates of 15 to 20 degrees. The construction of the present tent without poles in the center is a very real advantage and is one of its best features. Blackout features are obvious and require no comment.

b. The disadvantages that we have noted in using a trailer as an operating room is the lack of space and loss of time setting up for the next case in the same trailer. Using a tent for an operating room without a truck has a great disadvantage in having no provision for storage of sterile goods and supplies. To be sure boxes may be constructed, but our experience to date in setting up showed us lumber was impossible to obtain for such purposes.

c. The greatest advantage we noted in use of the trailers was the space to store sterile goods, the ease of operation of the sterilizers, the abundance of sterile water, hot and cold, and the ability to use each operating trailer for certain types of cases. Operative infections were at a minimum. In over eight hundred and fifty (850) procedures, only one infection of any consequence ensued and this was undoubtedly due to improperly preparing the patient's skin.

d. From the use of these trailers we learned a few things which might be corrected in further construction and might be mentioned here. The ventilation in the sterilizer trailer was inadequate; the lights, fans, and electrical equipment were not standard. It was found very difficult to obtain parts for replacement. In the X-ray trailer the file for storing films should not be in the darkroom. A homemade desert cooler on the X-ray trailer dropped the temperature 20 degrees in the darkroom. The developing tank was only 2-1/2 gallons permitting the development of only two films at a time; it was replaced by a 6-gallon tank which fitted easily in the same space. The pass box going to the darkroom was not large enough to take a



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14 x 17 cassette. We cannot comment on mobility as these were used as fixed units.

e. In the present surgical truck it would be a distinct advantage especially if the sterilizer should be permanently placed inside, to make some provision for a desert cooler. A small fan is already in place; this might be enlarged or at least an outlet sufficiently large might be constructed so such a cooler could be improvised if the need arose.

f. If a man trained in the running and repair of all the mechanical and electrical features of the truck could go with it, he could train the personnel which would be attached to the truck. This would have been a distinct advantage with the Carlisle trailers.

g. The question has been raised as to the use of fixed space for storage rather than movable cases. Any accident that would damage the truck body would probably render useless the supplies contained therein whether boxed or in stationary cupboards. The fact that the truck is standard and the body can be lifted off the chassis onto another would minimize the possibility of not using it because of mechanical breakdown. There is also a very decided advantage in being able to take goods out of a cupboard, rather than boxes, which would have to be spread out over a considerable area in order to get at their contents. The boxes, of course, might be constructed like cupboards but then would come the problem of fastening them securely with the truck in motion.

h. Whether the autoclave is to be in or out of the truck is not yet decided. Its use outside of the truck would permit sterilization of supplies in the absence of the truck. This would also keep to a minimum the number of people working inside the truck. Autoclaving inside the truck would also add to its heat.

4. Conclusion. We believe this unit is a very definite advance over previous units. We also believe that it opens up many possibilities for use with small surgical teams and also surgical and evacuation hospitals. In fact from the rather limited experience the writers already have had with an evacuation hospital under varying conditions, they would think it a privilege if they had the opportunity of setting up with several of these units in their authorized equipment.

/s/ Donald McNeil  
/t/ Donald McNeil  
Lt. Col., Medical Corps  
Chief, Surgical Service

/s/ Margaret E. Gaynor  
/t/ Margaret E. Gaynor  
2nd Lt., Army Nurse Corps  
Asst. Chief Surgical Nurse

51st Evacuation Hospital  
A.P.O. 180  
c/o Postmaster  
Los Angeles, Calif.

2. Incls -  
Incl 1 - List of Packs  
Incl 2 - List of Equipment

THE HISTORY OF THE

1847

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SURGICAL PACKS FOR SURGICAL UNIT

Based on 80 Major Operations

MAJOR PACKS 20

- 3 Gowns
- 3 Sheets:
  - 2 Fan folded
  - 1 Folded in square used as inside wrapper and instrument table cover.
- 8 Towels
- 1 Pillow case
- 6 Abdominal tape sponges
- 25 Surgical sponges, 4" x 4"
- 25 Surgical sponges, 4" x 8"
- 1 Abdominal pad, 8" x 10"
- 1 Abdominal pad, 12" x 16"

This pack is wrapped in 2 yards, double thickness muslin.

MINOR PACKS 60

- 2 Sheets (fan folded)
- 8 Towels
- 1 Pillow case
- 6 Abdominal tape sponges
- 25 Surgical sponges, 4" x 4"
- 25 Surgical sponges, 4" x 8"
- 1 Abdominal pad, 8" x 10"
- 1 Abdominal pad, 12" x 16"

This pack was wrapped in 1-1/2 yards, double thickness muslin.

EXTRA STERILE SUPPLIES

- 36 Gowns (May be packed in 5 - 14" sterilizer drums or wrapped separately in muslin.)
- 500 (1 bag) Surgical sponges, 4" x 4" (May be packed in 1 - 9" sterilizer drum.)
- 70 Surgical pads, 8" x 10" ) May be packed in 4 - 9"
- 80 Surgical pads, 12" x 16" ) sterilizer drums.

ENAMELWARE FOR STERILIZATION

- 12 Basin, hand - Wrapped in sets of 2 with muslin double thickness - making 6 sets.
- 12 Basin, sponge - Wrapped in set of 2 with muslin double thickness - making 6 sets.
- 4 Pitchers - - Wrap 2 in muslin for sterile use, Keep 2 unsterile.

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EQUIPMENT FOR SURGICAL TRUCK

Items to be Increased to Original List:

71720	Sheets	180	96
71780	Towel, hand	640	500
75900	Oil, typewriter, 2 oz, bottle	2	1
76640	Twine, Jute, coarse	3	1
78800	Pitcher, 5 - quart	4	2
92125	Sponge, surgical, 4" x 4"	5	2
92127	Sponge, surgical, 4" x 8"	5	2
93770	Silk, suture braided	15	5
99575	Table, instrument, folding	4	3

Original List

Items to be Removed from Original List:

34990	Sound, 18F	ea.	1
35010	Sound, 22F	ea.	1
97642	M.D. Chest, surgical A	ea.	2

Items to be Added to Original List:

11590	Cresol, Saponated Sol.	qt.	6 (for steri- lization of sharps & needles)
14700	Talc, purified	lb.	2
1K20605	Nikethamide (Coramine)	25 ea.	4
20270	Muslin	yd.	150 (for initial wrapping of sterile supplies)
20400	Stockinette, 6"	roll	3 } To be cut on
20410	Stockinette, 9"	roll	3 } the bias
			) and made
			) into com-
			) pression
			) bandages of
			) of 5 yds
			) each.
20420	Wadding, Sheet	roll	50
34920	Shears, Plaster Paris	ea.	1
37615	Splint, accessory, asbestos felt, soft gray	yd.	1
37764	Suture catgut, chromic, size 00 with half-circle, non-traumatic needle	tube	200.



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Items to be Added to Original List

38750	Tube, stomach, 30F	ea.	1
38755	Tubing, drainage, 5/8"		
	Penrose	36" ea.	6
38757	Tubing, drainage, 7/8"		
	Penrose	36" ea.	6
38760	Tabing, rubber, 1/8"		
	(Dakin)	ft.	25
70880	Stool, revolving	ea.	3
70950	Table, instrument,		
	adjustable	ea.	2
78770	Pins, safety, large	card	6
79110	Sterilizer, controls	box	3
79120	Sterilizer drum 9"	ea.	5 (to pack extra surgical dressings)
79140	Sterilizer, drum, 14"	ea.	5 (to pack 35 extra gowns)
92119	Pad, surgical, 8" x 10"	bag	3
92121	Pad, surgical, 12" x 16"	bag	5
93320	Supplementary instrument, set (Genito Uninary injuries)	ea.	1

Items to be Added Depending on Type of Work:

31800	Drill, Bone, extra drill sets	ea.	3
31955	Extension apparatus, Kirschner (hand drill type)	ea.	1
31960	Extension apparatus, Steinman	ea.	1
31965	Extension apparatus, Steinman Pin 5"	ea.	12
	Extension apparatus, Steinman Pin 6 $\frac{1}{2}$ "	ea.	12
	Extension apparatus, Steinman Pin 8"	ea.	12





Appendix N



FINAL LIST OF EQUIPMENT, AS OF 29 JANUARY 1944, FOR TRUCK,  
2½-TON, 6X6, SURGICAL, OPERATING

[Penciled Note:]  
Final  
29 Jan 44

TRUCK, 2 1/2 TON, 6 X 6, SURGICAL, OPERATING

CLASS I

<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
10122	Acid, Boric, Ointment, USP:	4 oz	24
10480	Alcohol, USP:	Quart	12
11105	Caffeine, With Sodium Benzoate, 7.5. Gr Amp:	Dozen	2
11590	Cresol, Saponated Solution:	Quart	6
11646	Dextrose, 5% In Sterile Distilled Water	1000 cc	24
11650	Dextrose, 5% in Physiological Sodium Chloride Solution:	1000 cc	24
11747	Ephedrine Sulfate, NF VI, 100 Amp., 3/4 Gr:	Dozen	6
11790	Ether (For Anesthesia):	1/4 lb	100

RESTRICTED

<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
12725	Mercuric Cyanide Tablet:	100	5
13020	Normal Saline Solution Tab:	100	2
13340	Petrolatum, USP:	Pound	10
13390	Phenol, USP:	Pound	1
13806	Procaine Hydrochloride, USP, 150 MG Amp.:	10	10
13830	Procaine Hydrochloride, USP, 3 Gr Hypo Tab:	10	24
14120	Soap, Soft:	Pound	5
14306	Sodium Citrate, 4% Sterile Solution, 50 CC In Vial:	12	1
14622	Sulfadiazine, USP, 0.5 Gm (7.7 Gr) Tab:	1000	1
14623	Sulfadiazine Sodium, USP, 5 Gm Vial:	6	15
14636	Sulfanilamide, Crystalline, USP, 5 Grams In Sterile Individual Double-Wrapped Envelope:	Pkg	25
14640	Sulfathiazole Ophthalmic Ointment, 5%	Dozen	2
14700	Talc, Purified, USP:	Pound	2
14910	Water, Distilled, Sterile, Pyrogen Free:	1000 cc	6
14917	Water, Distilled, Sterile, Pyrogen Free:	25	2
14920	Wax, Bone, Sterile:	2 gm	6
14940	Whisky, USP:	Quart	2
16088	Serum, Normal Human Plasma, Dried:	Pkg	48

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RESTRICTED

<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
<u>CLASS 1K</u>			
1K01075	Adherent, For Skin Traction:	4 oz	3
1K00600	Epinephrine (Adrenalin) Hydrochloride, NNR, 1:1000 Solution:	Dozen	2
1K35605	Merthiolate, Tincture, NNR, 1:1000:	Pint	12
1K20605	Nikethamide (Coramine):	25	1
1K56700	Pentothal Sodium With Sterile Distilled Water:	25	7

<u>CLASS 2</u>			
20024	Bandage, Elastic, All Cotton:	Dozen	2
20130	Cotton, Absorbent, Compressed:	Ounce	25
20140	Cotton, Absorbent, Roll:	Pound	2
20150	Cotton Batting:	Pound	5
20254	Mask, Face, Surgical, Improved:	120	1
20250	Muslin:	Yard	200
20340	Plaster, Adhesive, 1-Inch:	Spool	24
20350	Plaster, Adhesive, 3-Inch:	Spool	24
20390	Stockinet, 3-Inch:	Roll	3
20400	Stockinet, 6-Inch:	Roll	3
20410	Stockinet, 9-Inch:	Roll	1
20420	Wadding, Sheet:	Roll	200

<u>CLASS III</u>			
31130	Catheter, Urethral, Rubber, Self- Retaining:	Each	12
31133	Catheter, Urethral, Rubber, Self- Retaining, 4-Wing, Malecot, 32F:	Each	12
31790	Drill, Bone:	Set	1

RESTRICTED

Item No.	Item	Unit	Quantity
31800	Drill, Bone, Extra Drills:	Set	4
31955	Extension Apparatus, Kirschner, Hand Drill Type:	Each	1
31960-10	Extension Apparatus, Steinmann: New Type:	Each	1
31965-04	Extension Apparatus, Steinmann, Pin: 5-Inch	Each	12
31965-06	Extension Apparatus, Steinmann, Pin: 6 1/2-Inch	Each	12
31965-08	Extension Apparatus, Steinmann, Pin: 8-Inch	Each	12
33620	Needle, Spinal Puncture, Corrosion Resisting Steel, 20 Gage:	Each	12
33623	Needle, Abdominal, 1 3/4-Inches, Straight:	6	6
33791	Needle, Intestinal, Size 2, Half-Circle:	Pkg	6
33796	Needle, Intestinal, Size 3, Half-Circle:	Pkg	6
33802	Needle, Intestinal, Size 4, Half-Circle:	Pkg	6
33805	Needle, Intestinal, Size 3, Half-Circle, Fine:	6	6
33807	Needle, Intestinal, Size 4, Half-Circle, Fine:	6	6
33809	Needle, Intestinal, Size 6, Half-Circle, Fine:	6	6
33845	Needle, Skin Suture, 3 1/2-Inches:	Pkg	2
33865	Needle, Skin Suture, 2 1/2-Inches:	Pkg	3
33950	Needle, Surgeon's Regular, Size 12, 3/8-Circle:	Pkg	6
33961	Needle, Surgeon's Regular, Size 16, 3/8-Circle:	Pkg	6



RESTRICTED

<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
33965	Needle, Surgeon's Regular, Size 18, 3/8-Circle:	Pkg	6
34920	Shears, Plaster Paris:	Each	1
36030	Adapter, For Tubing:	Each	12
36215	Battery Box:	Each	1
36624	Cotton Thread, No. 80:	Spool	6
36626	Cotton Thread, No. 40:	Spool	6
36680	Depressor, Tongue:	Carton	2
36810	Gloves, Medium, Size 6 1/2:	Pair	24
36830	Gloves, Medium, Size 7 1/2:	Pair	24
36840	Gloves, Medium, Size 8:	Pair	24
37050	Irrigator Tubing:	Each	4
37055	Kit, Suction:	Each	1
37275-08	Rheostat, Lamp Socket Type: 110V, 60C, SP, AC	Each	1
37615	Splint, Accessory, Asbestos-Felt, Soft, Gray:	Yard	2
37750-08	Suction Apparatus, Portable, Electric: 110V, 60C SP, AC	Each	1
37762	Suture, Catgut, Chromic, Size 00, With 1 3/4-Inch Straight, Non- Traumatic Needle Affixed:	Pkg	10
37764	Suture, Catgut, Chromic, Size 00, With 1 1/8-Inch Half-Circle, Non- Traumatic Needle Affixed:	Pkg	10
37770	Suture, Catgut, Chromic, Size 00:	Tube	100
37780	Suture, Catgut, Chromic, Size 0:	Tube	100
37790	Suture, Catgut, Chromic, Size 1:	Tube	100
37840	Suture, Catgut, Plain, Size 00:	Tube	100

Item		Item	Unit	Quantity
No.				
37971		Suture, Silk, Braided, Non-Capillary, Size 00:	Spool	4
37975		Suture, Silk, Braided, Non-Capillary, Size 1:	Spool	2
37988		Suture, Silk, Braided, Non-Capillary, Size 3:	Spool	2
37995		Suture, Silk, Dermal, Coarse:	Pkg	50
38510		Syringe, Luer, Needle, 19 Gage, 1 3/4 Inch Canula:	Dozen	1
38705-09		Tube, Duodenal, Levin's: 16F	Each	12
38720		Tube, Murphy Drip:	Each	12
38750		Tube, Stomach:	Each	1
38755		Tubing, Drainage, 5/8-Inch:	Each	12
38757		Tubing, Drainage, 7/8-Inch:	Each	12
38780		Tubing, Rubber, 1/4-Inch:	Foot	24
38792		Tubing, Rubber, Latex, 3/16-Inch:	Foot	48
38793		Tubing, Rubber, Latex, 3/16-Inch:	Foot	60
38900		Wire, Corrosion-Resisting Steel, 0.014-Inch:	Spool	1
38910		Wire, Corrosion-Resisting Steel, 0.028-Inch:	Coil	2
<u>CLASS IV</u>				
41808		Clamp, Shut-Off, Screw Adjustment	Each	18
44630		Tubing, Rubber, Pressure, 3/16-Inch:	Foot	6
<u>CLASS VII</u>				
71600-5		Gown, Operating: Large:	Each	24
71600-10		Gown, Operating: Medium:	Each	36
71600-15		Gown, Operating: Small:	Each	12
71690		Pillow Case:	Each	80



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<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
71720	Sheet:	Each	120
71780	Towel, Hand:	Each	640
73690	Pot, Stock, 24 Qt, With Faucet And Strainer:	Each	2
74510	Broom, Corn:	Each	2
74560	Brush, Hand:	Each	24
74590	Brush, Scrub:	Each	4
74680	Lye:	Can	3
74890	Soap, Laundry:	Bar	24
74930	Soap, White, Floating:	Bar	24
74935	Steel Wool:	Pkg	1
75040	Bag, Paper, 5 lbs:	Pkg	1
75900	Oil, Typewriter:	2 oz	2
76290	Pencil, Wax, Blue:	Each	2
76440	Shears, Office:	Each	1
76640	Twine, Jute, Coarse:	Ball	3
76650	Twine, Jute, Fine:	Ball	1
77010	Aprons, Rubberized:	Each	6
77020	Atomizer, Hand:	Each	2
77025	Atomizer, Hand, Rubber Bulb:	Each	4
77110	Basin, Hand:	Each	12
77130	Basin, Pus:	Each	6
77150	Basin, Sponge:	Each	12
**77160	Battery, Dry Cell: 32 for Item 78010 and 12 for Item 36215	Each	44
77170	Bedpan:	Each	2

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<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
77550	Clothesline:	Foot	100
78010	Flashlight:	Each	8
78020	Flashlight Lamp:	Each	16
78050	Funnel, 6-Inch:	Each	4
78130	Graduate, 500 CC:	Each	2
78180	Hatchet:	Each	1
78220	Irrigator:	Each	2
78250	Jar, 8 Oz:	Each	2
78680	Paper, Toilet:	Roll	12
78770	Pins, Safety, Large:	Card	6
78800	Pitcher, Approximately 5 Qt:	Each	4
79000	Sheeting, Rubber:	Yard	2
79110	Sterilizer Controls:	Box	2
79130	Sterilizer, Drum, 10-Inch:	Each	5
79140	Sterilizer, Drum, 14-Inch:	Each	5
79320	Thermometer, Clinical:	Each	6
79440	Urinal, Enamelware:	Each	2
NS-7	Support, Letter, Operating:	Set	3

CLASS IX

91070	Cocaine Hydrochloride, USP, 2 Gr Hypo Tab:	Tube	2
91155	Morphine Tartrate, 1/2 Gr Solution:	Box	80
92010	Bandage, Gauze, Compressed, 3-Inch:	Box	4
92030	Bandage, Plaster of Paris, 6-Inch:	Dozen	20
92040	Bandage, Triangular, Compressed:	Each	48



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<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
92050	Dressing, First-Aid, Large:	Pkg	50
92060	Dressing, First-Aid, Small:	Pkg	50
92117	Pack, Abdominal, 11 By 12 Inches, 80:	Bag	4
92121	Pad, Surgical, 12 By 16 Inches, 20:	Bag	8
92125	Sponge, Surgical, 4 By 4 Inches, 500:	Bag	6
92127	Sponge, Surgical, 4 By 8 Inches, 180:	Bag	12
93210	Basic Instrument Set, Complete (1942 Model):	Set	2
93250	Supplemental Instrument Set, Chest Injuries, Complete (1942 Model):	Set	1
93310	Supplemental Instrument Set, Fractures and Amputations, Orthopedic, Complete (1942 Model):	Set	1
93320	Supplemental Instrument Set, Genito- Urinary Injuries, Complete:	Set	1
93510	Anesthesia Set, Complete:	Set	2
93707	Shock Team Set, Complete:	Set	1
97465	Blanket Set, Small:	Each	2
97764	Kit, First Aid, Gas Casualty:	Each	2
97815	Splint Set:	Each	2
99145	Buckets, 3 In Nest:	Nest	2
99160-05	Cap, Operating: Large:	Each	12
99160-10	Cap, Operating: Medium:	Each	12
99185	Chair, Common, Folding:	Each	6
99280	Heater, Water:	Each	1
99285	Hone, Oil, 3 1/2-Inch:	Each	2

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<u>Item</u> <u>No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
99305	Irrigator Stand, Folding:	Each	3
99315	Lamp, Operating, Field:	Each	2
99376	Litter, Straight, Steel:	Each	2
99386	Litter Securing Strap:	Each	8
99410	Pad, Heat, Complete:	Each	12
99415	Pad, Heat, Refill:	Each	12
99523	Sterilizer, Instrument, 20-Inch:	Each	1
99530	Sterilizer, Instrument, 14-Inch:	Each	1
99540	Sterilizer, Instrument, 9 3/4-Inch:	Each	2
99555	Stove, 2-Burner, Gasoline:	Each	2
99575	Table, Instrument, Folding:	Each	4
99592	Tub, Wash 3 In Nest:	Set	1
99600-03	Unit, Power, Electric: 3 Kilowatt	Each	1
99616	Washboard:	Each	1
99650	Wringer, Clothes:	Each	1
75	Patient's Property Card	Each	500
76	Patient's Property Tag	Each	500
52B	Emergency Medical Tag (20 In Book In Duplicate)	Book	5



Appendix O

REPORT OF TRUCK, 2½-TON, 6 x 6, SURGICAL, OPERATING, SUBMITTED  
17 JANUARY 1944 BY COMMANDING OFFICER OF FOURTH AUXILIARY  
SURGICAL GROUP, LAWSON GENERAL HOSPITAL, ATLANTA, GEORGIA

REPORT ON TRUCK, 2½-TON, 6 X 6, SURGICAL, OPERATING

This truck was received at this station on 20 December, 1943, having been driven from Carlisle Barracks, Pennsylvania, fully loaded with trailer attached. At the time of arrival, the contents were checked for breakage and it was noted not a single bottle was broken and so far as could be determined, none of the items were damaged by the trip. It was noted, however, that, due to inadequate drainage, the faucets in the rear of the truck, the condensation float on the sterilizer and the foot pedal under the sink were frozen. These were thawed out and for the remainder of the test period the truck was kept in a garage whenever the weather was cold and the truck was not actually in use.

The unit was set up between two wards of Lawson General Hospital and twelve operations were performed. These included: (1) Ligation of varicose veins, leg, right; (2) Hemorrhoidectomy; (3) Incision and drainage of pilonidal abscess; (4) Sequestectomy, thumb; (5) Excision of pilonidal cyst; (6) Revision of plaster cast, leg; (7) Change arm cast, surgical dressing; (8) Application of body cast; (9) Application of leg cast; (10) Sequestectomy, femur, with saucerization; (11) Bronchoscopy; (12) Bronchoscopy. Throughout these operations, only the equipment carried in the truck was used. Instruments were found to be adequate in both number and type.

For the most part, the unit functioned in an excellent manner. The largest defect and one which caused almost con-

stant trouble was the steam sterilizer. Upon arrival the tank in the burner was found to have two small holes which made it impossible to maintain pressure within the tank. These were repaired, but other small leaks appeared from time to time. Inasmuch as Colonel Quinnell has informed us that this type combination steam sterilizer and water heater will not be used on future models, it is not believed necessary to go into details as to its defects. The following list is offered and a more detailed report on them can be submitted if required:

1. Steam is not produced rapidly enough or in sufficient quantity to enable the sterilizing unit to meet the demands of early operation and frequent operation.
2. Unit is incapable of safe mechanical operation while the truck is in motion.
3. Heating unit is unstable in its mechanical operation and requires constant attention to prevent breakdown. If door to burner is not kept open there is danger of overheating and if it is open the burner is subject to gusts of wind, materially reducing its efficiency.
4. Boiler capacity is inadequate. By the time sufficient steam has been created for adequate sterilization and hot water, the water in the boiler has been used, and, as the feed is of the gravity type, it is necessary to lose the head of steam in order to refill the tank. This makes it necessary to start over again with consequent loss of time.
5. Present unit has an exposed and vulnerable glass water gauge without any protection.
6. Condensation float is the length of the sterilizer from the thermometer and connected by  $\frac{1}{2}$ -inch pipe. Thus, the temperature at the float is at variance with the thermometer and allows steam to escape.
7. Due to the drop in steam pressure when the jacket is filled and again when the chamber is filled, considerably steam condenses on the inside of the sterilizer with consequent soaking of the surgical packs. For this reason, no pack can be allowed to touch the sides, which greatly reduces the capacity of the sterilizer of any one "run".



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8. At present hot water is obtained by passing steam thru a small tank under the main supply tank. If this is done while steam line from boiler to jacket and chamber is open, care must be taken not to draw off too much steam, or the pressure in boiler, jacket and chamber will fall below the 17 lbs. sterilizing pressure. If steam supply valve to sterilizer is closed when steam is drawn into the water tank there is the chance that the pressure will drop to a point where it is not possible to build it up fast enough to prevent chamber condensation from dropping the chamber pressure below the 17 lbs. sterilizing pressure. This would become a real problem if large quantities of hot water were used, and requires constant attention at all times.

The use of a separate steam sterilizing unit apart from the heating unit, such as is being planned, should solve these difficulties.

The hot air heater and fan gave no trouble and was quite efficient.

The small generator (Signal Corps, PE-75-T) ran constantly for several days at a time without any difficulty, and supplied sufficient power for all needs. There was, however, no heavy-duty cable to connect the generator to the truck. One was borrowed locally for this test, but should be included as part of the standard equipment. A length of 50 feet is recommended.

Operating was done in the tent supplied for the purpose, which was found to supply adequate space to allow two teams to work without crowding. The tent is not difficult to erect, but the white canvas flooring is difficult to keep clean. It is recommended that the eyelets used to raise the white inner tent be fastened to the tent poles in such a manner that they cannot be lost. Several were missing when the truck was delivered and were made locally. It is recommended that a six-foot vestibule be added to the tent entrance to form a light trap. This would enable litters to be carried in and out of the tent and maintain blackout precautions. The remainder of the truck and tent can be made light-proof without added equipment.

The lamps, field, operating (Item 99315) supplied sufficient light for operating and, together with the lamps fixed to the rear of the truck, made the illumination within the tent adequate for all purposes. The adapters on these lamps, used to accommodate 6-volt bulbs, require an extension on the center

contact in order to complete the circuit. This difficulty was overcome here by the addition of a drop of solder. These lamps were used with current supplied from the generator and from the truck battery. As no batteries were available, we were unable to try these lights with this source of current. It is noted that the original list of equipment calls for three of these lamps. Inasmuch as they are a large and bulky item and packing space is at a premium, it is suggested this number be reduced to two. Only two were used in this test and this number was found to be sufficient.

The litter supports were satisfactory and firm enough for operating purposes. It is suggested that the cross boards of these supports be notched to accommodate the curvature of occupied litter. It was noted during the operations that the cross boards were about at the level of the patient's shoulders and after a time caused considerable discomfort.

Within the truck, it was found that the door catches on the cabinets were unsatisfactory in several respects, and it is recommended that these be replaced by simple flat catches similar to those used to keep the drawers closed. The ones on the cabinets at present are too weak to hold unless they are in perfect condition. Furthermore, they protrude into the narrow aisle of the truck and there is considerable danger of them being damaged by passing personnel as well as, during the packing and unpacking of the truck, being broken by equipment packed in the aisle. During the test period here, none of these were broken, but several of the men received minor skin abrasions caused by striking them in passing down the aisle.

Window screens on the two windows would be a distinct advantage if the unit was functioning within an area where insects are plentiful. The blackout screens on these windows are quite satisfactory.

The goose-neck on the sink is too narrow for safe scrubbing, and, if possible, would suggest this be bent outwards to allow more clearance between the lip of the pipe and the upright section, thus eliminating the danger of contaminating the hands by contact with the unsterile piping.

While using the truck here we attached a simple flexible extension on the sink drainage pipe. At the present time, the sink drainage pipe drains on the spare tire under the truck body; hence, soapy water, chemicals, or whatever is discarded in the sink hits the tire and spatters. By means of this extension, drainage was directed over the tire and could be collected in buckets or directed into a suitable drainage ditch and carried off.

The power inlet plug on the left side of the truck body is



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at present exposed. This should be covered by a metal cover for protection when not in use.

The water tank is filled thru an opening in the top of the truck. At present, in order to fill the tank it is necessary to climb over the engine hood, up over the windshield and step across the top of the combat cab. Inasmuch as it is understood steel cabs will not be available, recommend that either a ladder be placed against the side of the truck or hand and toe holds so placed in the side that access to the tank inlet can be gained in this way. A similar situation exists for the gas tank supplying the hot air heater.

During the test period, considerable rainy weather was experienced. This caused a softening of the ground and the rear of the truck sunk slightly. Either for this reason or because of the natural slope of the truck, the rain from the truck roof drained into the eaves trough and, hence, over the electric outlet plugs and into the tent itself.

The unit as now constructed is not suitable for work in cold climates. The water pipes are outside and not insulated. During the test period these pipes froze at a temperature of 26° F. while the truck was in use. It is understood that later trucks will have inside plumbing and it is suggested that on the present models these exposed pipes be insulated to afford some protection from the cold. In this regard, no trouble was experienced from freezing of water or watery solutions inside the truck itself.

Despite weather below freezing during a considerable part of the actual operating time, no trouble was encountered in maintaining a comfortable temperature within the tent. The gasoline heaters, sterilizer and hot air heater on the truck kept the tent sufficiently warm thruout this period.

Inasmuch as all available space is utilized in packing the truck, a considerable quantity of material is placed above the cabinets. Fixed roof straps, buckling to the outer edge of the cabinets, would aid in securing these supplies, especially during travel over rough terrain.

Considerable attention was given to the equipment and supplies forwarded with the truck and trailer, including those supplies not available at Carlisle at time of shipment, but which were secured from local sources. Working on the assumption that the truck was to handle general surgical cases and the anticipation that enough supplies for 100 such cases were to be carried, but also bearing in mind the problems of storing these in transit, the tentative list of equipment was revised and the suggested list enclosed herewith.

The following explains the major changes which were made:

Chloroform was deleted because it was found that it was used so rarely and adequate substitutes were already included.

Epinephrine hydrochloride, item 11750, was deleted and epinephrine hydrochloride, item 1 E 0060, substituted. This was for greater ease in handling and administration.

The quantity of ether,  $\frac{1}{2}$ -lb. cans, was reduced from 150 to 100. Due to quantity of sodium pentothal supplies, it was believed 100 cans of ether to be sufficient. This item should not be hard to replenish and 100 cans is believed ample for one day's operating.

The quantity of pentothal sodium was also reduced. This is a bulky item and, although it was felt desirable to carry as much as possible, the space limitation had to be considered. In conjunction with other forms of anaesthesia available (ether, local, and spinal) it is believed that 7 units of 25 ampules each would be sufficient.

It is recommended that sulfathiazole ophthalmic ointment be substituted for yellow oxide of mercury ointment.

Item 13806, procaine hydrochloride, 150 mgm amp, was increased from 5 units to 10 units. This was done because of the reduction in sodium pentothal and but little extra space was involved.

Item 13830, procaine hydrochloride, 3-gr. hypo tab, was increased to 24 units for the same reason.

Item 14636, sulfanilamide, crystalline, 5 gms. in sterile individual double wrapped envelopes with shaker top was reduced from 200 units to 25 units. Each of these units contains 12 envelopes which gives a total of 300 envelopes, which is believed adequate for 100 cases. It is also believed this item is easily replenished and hence there is little necessity of carrying too large a supply initially.

Item 14623, sulfadiazine sodium, 5 gm. vial, was increased from 3 units of 6 vials to 15 units of 6 vials. This increase believed necessary to handle the cases where either vomiting or the presence of stomach



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or intestinal wounds would render the administration of sulfa drugs by mouth undesirable.

Item 14910, water, distilled, sterile, 1000 cc., was reduced from 24 bottles to 6 bottles. This was done to save packing space and was compensated by the suggested addition of item 14917, water, distilled, sterile, 50 cc. ampules, 2 units of 25 ampules each. It is anticipated that this water would be used, for the most part, in the preparation of local anaesthetics. For this, the smaller size unit is believed more economical and easier to handle.

Item 14940, whiskey, was reduced from 6 quarts to 2 quarts. This item, while in some respects desirable, is space consuming and probably not used to any great extent for medicinal purposes.

Items 20130, 20140 and 20150 were all reduced considerably. These items, (cotton and cotton batting) while not heavy are bulky and, hence, space consuming and it is believed the quantities recommended in the revised list would be adequate for general surgical teams for 100 cases. If considerable orthopedic work was contemplated, these items might be increased.

Item 20390, stockinet, 3-inch, was added and item 20410, stockinet, 9-inch, reduced to 1 roll.

Item 20420, wadding, sheet, was increased to 200 rolls. This packs well and was believed advisable with the reduction of cotton batting.

Item 31790, drill, bone, was proposed as an addition. While one is present in the fracture kit, another was believed advisable as a spare.

Item 31133, catheter, urethral, rubber, self-retaining, Malecot, 32-F, was increased for use in chest wounds.

The needles were not materially changed as there was little space involved. It is recommended, however, that some small cutting needles be included.

Item 36990, intravenous solution, reservoir, was deleted. These are difficult to pack and not believed necessary. Other items already included can be used wherever this item was necessary.

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Items 37780, 37790, 37840 and 37995 (sutures) were materially reduced and the amount left believed more than adequate for 100 operations.

Item 38705, tube, duodenal, drainage, Levin's, 16-F, was increased to 12. Little space is involved with the packing of the additional 6 tubes and with the contemplated set-up for this unit, a tube placed during the operation would leave with the patient and probably not be recovered.

Items 38900 and 38910, wire, corrosion resisting steel, were deleted as sufficient wire of this type is present in the instrument kits.

Item 44020, sterilizer, hot air, large, was not supplied with the truck. From the description, this item would occupy considerable space in packing and is not believed to be of sufficient use to justify its inclusion.

Items 71600, 71690 and 71720, gowns, pillow cases and sheets, were all reduced. The numbers recommended on the revised list take care of the packs and leave some excess. This space saved by this reduction can be better utilized for other supplies.

Item 77010, aprons, rubber, operating, were increased to 6 to supply one to each of the two scrub nurses.

Item 79000, rubber sheeting, 2 yards suggested as addition to equipment list to be used in connection with wound irrigation.

Also suggested addition of item 74590, brush, scrub, 2 to be used for scrubbing the canvas flooring of the operating tent.

Item 91155, morphine tartrate,  $\frac{1}{2}$ -gr. solution, has been recommended cut from 200 units to 80 units. Each of these contains 5 syrettes for a total of 300 doses, which is believed adequate.

Item 92030, bandage, plaster of paris, 6-inch, has been cut to 20 units of one dozen each instead of 40 units. This item is both bulky and heavy and 20 units is believed adequate for 100 general surgical cases. It is recognized that some cases will, in addition to such wounds as render them general surgical cases, also have fractures which it is desirable to treat at the same time. It is believed, however, that

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20 units of plaster bandage is sufficient for this purpose. Should the truck be used for any considerable number of orthopedic cases, this probably would not suffice, but it is our understanding that such is not the purpose of this particular operating unit.

Item 92040, bandage, triangular, compressed, was reduced from 96 to 50. This is believed sufficient for the proposed number of cases to be handled.

Item 92127, sponge, surgical, 4x8, was increased to 12 bags and item 92125, sponge, surgical, 4x4, 5 bags added. This will care for those in the packs and leave an extra supply, easily packed in the sterilizer drums. These are extremely useful and packed in the sterilizer drums will not require additional space. Each bag of 4x8's contains 180 sponges, hence, the 5 bags on the original list would supply 900 sponges. The 80 surgical packs as shipped made up contain 25 sponges (4x8) or a total of 2000 sponges. Hence, the 5 bags of item 92127 are entirely inadequate.

It is recommended that item 97639, chest, plasma, complete, be deleted and that item 16088, serum, normal, human plasma, be substituted. It is further recommended that this be packed in export packages of 12 units to each package. It is believed that by this substitution, an adequate supply of plasma could be carried in a much smaller space. Would recommended 48 packages of this unit be included.

Item 97758, gas casualty case was deleted and item 97764, kit, first aid, gas casualty, substituted. Item 97758 is bulky and heavy, and its use would probably not be sufficient to justify its inclusion in the list of equipment.

The number of units of item 99415, pad, heating, refill, has been reduced from 36 to 12. This allows one refill for each of the 12 pads, which is believed sufficient.

Item 70880, stool, revolving, 3, was deleted. Although this is a desirable item to carry if space would permit, the limitation of such space makes it necessary to recommend its exclusion. These stools are awkward to pack and can not be broken down. The equipment already contains 6 folding chairs which are easily packed and are satisfactory. During the test period, none of these revolving stools were used and no serious discomfort resulted.

In addition, the following items are recommended as additions to the table of equipment:

	<u>Item</u>	<u>Unit</u>	<u>Amount</u>
1K01075	Adherent for Skin	4 oz	3
75040	Bag, Paper, 5-lbs.	500	1
78250	Jar, 8-oz.	ea.	2
20020	Bandage, Elastic	doz.	2
44630	Tubing, Rubber, Pressure	ft.	6
99530	Sterilizer, Instrument, 14-inch	ea.	1
99540	Sterilizer, Instrument, 9-inch	ea.	2
93707	Shock Team Set, Complete	ea.	1

For economy in packing space and ease in handling, it is recommended that item 97455, blanket set, large, be deleted and that two units of item 97465, blanket set, small, be substituted. While this would result in a total reduction of several blankets, it is believed sufficient blankets would remain to fulfill all requirements.

The supplemental chest, thoracic set, was supplied without either battery box or batteries. These must be included in order to use the bronchoscope. In this connection, it was noted that the supply catalog contains an item 37275, rheostat, lamp socket type. If this apparatus could be used in connection with the generator of the surgical truck and connected to the bronchoscope, it would be far better than the packing of a battery box and batteries. One or the other should be supplied, however.

If a syringe holder for administration of sodium pentothal is available, it is heartily recommended that two of these items be added. The anaesthetists in this group feel that the administration of sodium pentothal is much more satisfactory with these holders.

It is also suggested that a small, portable, ether-oxygen machine or portable resuscitator, capable of administering either oxygen or air under low pressure, be added, if available.

The truck and trailer were packed with the items on the revised list and it was found that there is adequate space available and still leave room within the truck for two people to work while the truck is in transit. Such personnel could be preparing surgical packs or, with the proposed type of inside sterilizer and heating unit, actually be sterilizing equipment while the truck was in motion.



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The unit as a whole was considered to be quite satisfactory. With the exception of the steam sterilizer, all defects reported above may be considered minor. The proposed list of equipment will undoubtedly have to be altered, depending upon the peculiar conditions existing in the particular theatre where this operating unit is functioning, but it is believed that this list, as suggested, is fairly complete for a basic unit.

Weather conditions during the days when operations were actually performed were anything but ideal, consisting of rain, wind and, at times, sub-freezing temperatures. Throughout this period, however, the operating tent was both warm and dry so that neither the patients nor the surgeons suffered any discomfort.

/s/ H. A. Kind

/t/ H. A. KIND  
Lt Col, MC





Appendix F

REPORT ON TRUCK, SURGICAL, OPERATING,  $2\frac{1}{2}$  TON, 6x6, SUBMITTED  
ON 25 MAY 1944 BY HEADQUARTERS, FIFTH AUXILIARY SURGICAL GROUP,  
FORT SAM HOUSTON, TEXAS

REPORT ON TRUCK, SURGICAL, OPERATING,

$2\frac{1}{2}$  Ton, 6 x 6

This truck was received at this station on the 8th of March 1944, having been driven from Lawson General Hospital, fully loaded with the Trailer attached. The truck ran well enroute, no mechanical difficulties being encountered. It was found that the attachment of the cabinets on the inside of the truck were inadequate and worked loose during the trip. This has been corrected to some extent by bracing the cabinets with a board placed at the rear of the truck between the ends of the cabinets. It is recommended that in the final models of the truck the cabinets be given stronger attachments to the wall of the truck and that a brace be placed between the ends of the cabinets just above the rear door.

The truck has been used continuously since its arrival here both in the performance of animal surgery and in ASF demonstrations. The unit has functioned well and the defects found are essentially the same as those noted by the Fourth Auxiliary Surgical Group. A copy of their report is enclosed. We concur with their report with the following additions and exceptions.

The steam sterilizer as previously reported was inadequate. The following corrections were made:

- 1 The burner supplied was replaced by a Plumbers

Furnace, Clayton and Lambert, Stock No. 22, obtained from the Post Engineers. This unit was found to be adequate once steam was generated although it required forty-five (45) minutes to develop an adequate head of steam.

2. The steam inlet to the jacket was changed from the top of the autoclave to the posterior inferior jacket opening. With the previous inlet to the jacket the water of condensation accumulated in the jacket and at no time previous to this change was there adequate temperature developed in the jacket. Further there was no way to drain the accumulated water of condensation from the jacket until the new connection was installed.

3. The pipe line from the boiler to the jacket was changed to make it as short as possible. The previous pipe-line was too long and in an exposed position, thus wasting a large amount of heat.

4. A vacuum attachment was run off the former opening to the jacket and attached to the chamber exhaust pipe.

With the above changes the autoclave was found to run in a very satisfactory manner. The addition of the vacuum speeded the drying of the autoclaved material and should be installed in all the new models. The autoclave may now be run constantly without the former great loss of water. Once steam is generated it functions almost as rapidly as any of the standard small commercial models. It can now function continuously for four (4) complete loads without the addition of water. It can operate satisfactorily while in transit.

The use of the steam from the autoclave to heat the hot water has not been corrected. We advise that a separate water heating unit be installed to avoid the loss of steam from the autoclave. It is also recommended that the heating units be placed further away from the gasoline tank.

Chloroform should not be deleted as it is believed that it will be required as a substitute for ether in cases in which the latter, while being the anesthetic of choice, is contraindicated because of its inflammability.

Item 92030, bandage, plaster of paris, 6 inch, should be retained at 40 units instead of the recommended cut to 20 units. We have found that this item is rapidly expended when a large number of fractures were simulated and believe that it should not be reduced. The advisability of using plaster in many cases of extensive wounds without fractures, and the fact that the unit will be preparing its cases for evacuation we believe further warrants the retention of 40 units of



the plaster of paris.

The addition of a portable fracture table is believed to be very necessary. The application of plaster casts with the patient on the present operating tables is most satisfactory. Item 70994, Table, Orthopedic, Portable, with arm traction bar, complete with carrying case, is recommended.

The recommended addition of the syringe holders for the administration of sodium pentothol and the portable ether-oxygen machine we believe to be very important and strongly advise their inclusion into the equipment.

The windows of the tent should be enlarged to give better lighting and mosquito netting should be supplied so that when the walls are rolled up for operating in hot weather, the tent could still be flyproofed.

The litter supports should be higher so that the litter is supported at the level of an operating table.

The present Mayo stands, although adequate, would be more satisfactory if larger and more stable.

The addition of four small collapsible tables, one for a splash basin, and one for an additional utility table to each theater is recommended.

A ceiling ventilator with a fan should be placed in the roof of the truck as the autoclave makes the inside of the truck very hot when it is running.

An extension cord with multiple outlets should be supplied so that the electric generator could be used when the truck is not attached to the tent.

An increase in the volume of water that the truck can carry would be desirable.

The supply of needles is adequate, but small needles are lacking and should be added.

Double rear view mirrors should be installed chiefly for use in backing the truck into the tent opening.

Larger fire extinguishers should be provided, especially a carbon dioxide extinguisher for gasoline fires.

For the Commanding OFFICER:

DUGALD S. MacINTYRE  
Lt. Col., MC  
Executive Officer





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Appendix Q

COPY OF MEMORANDUM FROM HEADQUARTERS; ARMY SERVICE FORCES,  
DIRECTING CHIEFS OF TECHNICAL SERVICES TO PREPARE INDIVIDUAL  
HISTORIES OF WARTIME RESEARCH AND DEVELOPMENT

WAR DEPARTMENT  
HEADQUARTERS ARMY SERVICE FORCES  
WASHINGTON

SPROD

31 July 1944

RMO/ah  
4513

MEMORANDUM FOR THE CHIEF, CHEMICAL WARFARE SERVICE  
THE CHIEF OF ENGINEERS  
THE CHIEF OF ORDNANCE  
THE CHIEF OF TRANSPORTATION  
THE CHIEF SIGNAL OFFICER  
THE QUARTERMASTER GENERAL  
THE SURGEON GENERAL

Subject: History of Wartime Research  
and Development.

1. It is desired that each Chief of Technical Service initiate at this time a continuing project, to be completed within six months of the termination of hostilities, to prepare a complete illustrated history of wartime research and development for his respective technical service. This project should be undertaken with the objective of furnishing:

a. A guide to future research and development personnel to prevent or discourage repetition of unsuccessful investigations.

b. A ready reference text or source book for

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research and development personnel to indicate a line of research and development to be followed or avoided.

c. A source of information for personnel charged with the preparation of military characteristics.

d. A source of information to those responsible for the initiation or approval of development projects to be used as a background for approving or disapproving project initiation.

e. A factual text for historians and others requiring correct information on the many varieties of research and development projects undertaken during the war.

f. A reference manual for staff planners to assist them in the preparation of future war plans.

2. As a minimum the documentary evidence prepared by each technical service should be objective and factual and should include:

a. A table of contents.

b. For each item or program discussed

(1) The purpose or objective of the program or project.

(2) A brief description of the item or program.

(3) A cross reference to related items or programs.

(4) A brief resume of results attained.

(5) Illustrations of the item or program where applicable.

c. Index.

3. The finished document will be classified not lower than secret and each item or program contained therein will be given an individual security classification. Distribution will be held to the minimum within the technical service, and distribution outside the technical service will be as follows:

a. Joint Chiefs of Staff - 2

b. Assistant Chief of Staff, G-4, War Department  
General Staff - 2



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- c. Commanding General, Army Air Forces - 2
- d. Commanding General, Army Ground Forces - 2
- e. Commanding General, Army Service Forces - 2
- f. Commander in Chief, U. S. Navy - 1
- g. Commandant, U. S. Marine Corps - 1
- h. The Adjutant General - 1

For the Commanding General:

LUCIUS D. CLAY,  
Major General, General Staff Corps,  
Director of Material.

1. The first part of the book is devoted to a general survey of the subject.
2. The second part is devoted to a detailed study of the various aspects of the subject.
3. The third part is devoted to a study of the various methods of the subject.
4. The fourth part is devoted to a study of the various results of the subject.
5. The fifth part is devoted to a study of the various applications of the subject.
6. The sixth part is devoted to a study of the various problems of the subject.
7. The seventh part is devoted to a study of the various theories of the subject.
8. The eighth part is devoted to a study of the various hypotheses of the subject.
9. The ninth part is devoted to a study of the various experiments of the subject.
10. The tenth part is devoted to a study of the various observations of the subject.

THE END OF THE FIRST PART



Appendix R

OUTLINE USED IN PREPARATION OF INDIVIDUAL DEVELOPMENT PROJECT  
HISTORIES INCLUDED IN MONOGRAPH ON WARTIME RESEARCH AND  
DEVELOPMENT OF MEDICAL FIELD EQUIPMENT

I. Historcial Background.

- A. Description of earlier models.
- B. Advantages and disadvantages of each.
- C. Discussion of technical details (where relevant to present project)..

II. Project Initiation.

- A. Original project proposal.
  - 1. Purpose or objective.
  - 2. Existence of a firm military requirement.
  - 3. Military characteristics.
  - 4. Funds requested.
  - 5. Research plan.
- B. Processing the proposal.
  - 1. Procedural steps followed.
    - a. Medical Department Equipment Laboratory.

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- b. Research and development agency, Surgeon General's Office.
- c. Medical Department Technical Subcommittee.
- d. Medical Department Technical Committee.
- e. The Surgeon General.
- f. Headquarters, Army Service Forces, (or other higher echelons.

2. Substantive changes introduced.

III. Development Phase.

A. Preliminary survey of research possibilities (scientific literature, trade catalogues, related projects, etc.).

- 1. Foreign (civilian and military).
- 2. Domestic (civilian and military).

B. Actual development work.

1. Agencies participating.

- a. Medical Department Equipment Laboratory.
- b. Private industry.
- c. The Surgeon General's Office.
- d. Other agencies.

2. Major structural problems.

3. Construction progress.

6. Testing stage.

- 1. Preparations for field testing.
- 2. Analysis of tests conducted.
- 3. Summary of findings and recommendations.

D. Modifications prior to standardization.



IV. Standardization Phase.

A. Procedural steps followed.

1. Medical Department Equipment Laboratory.
2. Research and development agency, Surgeon General's Office.
3. Medical Department Technical Subcommittee.
4. Medical Department Technical Committee.
5. The Surgeon General.
6. Headquarters, Army Service Forces, (or other higher echelons).

B. Standardization data (especially the following).

1. Nomenclature.
2. Unit.
3. Basis of issue.
4. Quantity to be procured (including estimated cost).

C. Major controversies at any of the above stages.

1. Changes made.
2. Suggested changes overruled.

V. Procurement Phase.

A. Data from Army Medical Purchasing Office.

1. Initial production contract (date, quantity, unit cost).
2. Deliveries on initial contract (dates; quantities).
3. Total procurement to date (quantity; unit cost changes, if any).
4. Total deliveries to date (quantity).

## VI. Evaluation of Project.

UNCLASSIFIED

- A. The item ("expert opinion"; present catalogue classification; overseas reactions, etc.).
- B. Administration of the project (especially inter-agency coordination).
- C. Procedural aspects (see AR 850-25).
- D. Other aspects of project meriting attention.





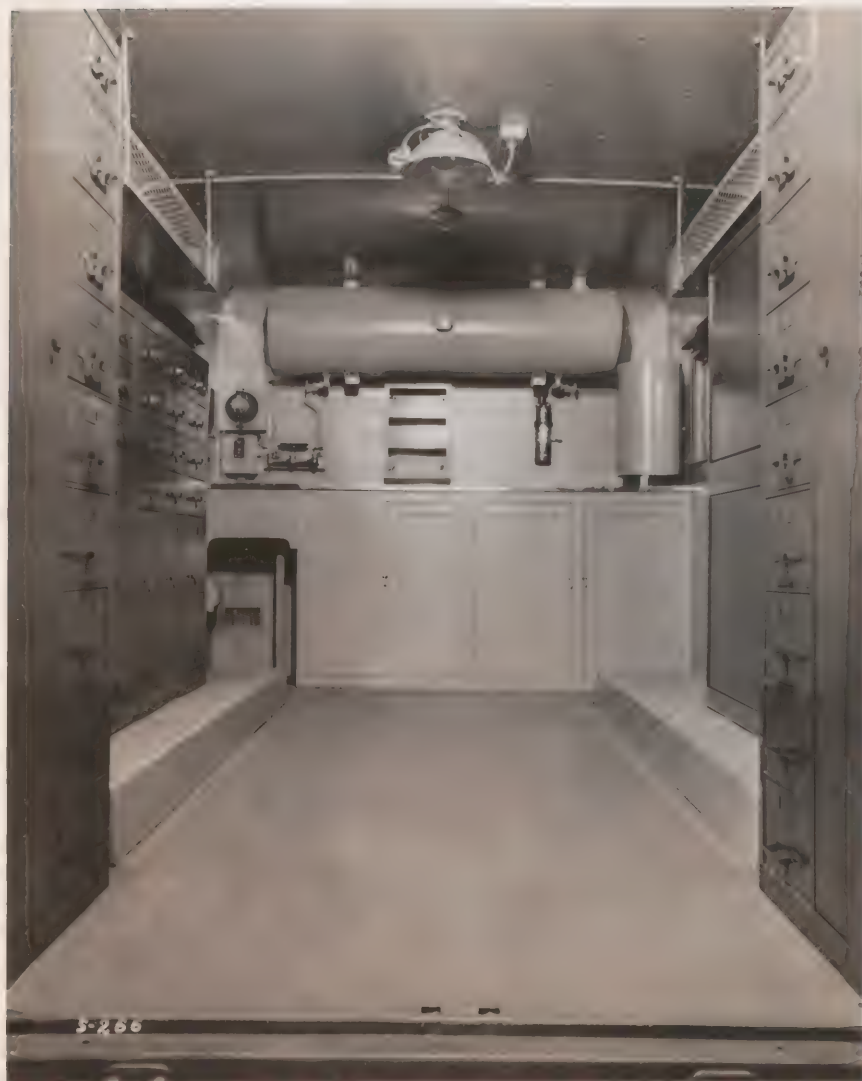




























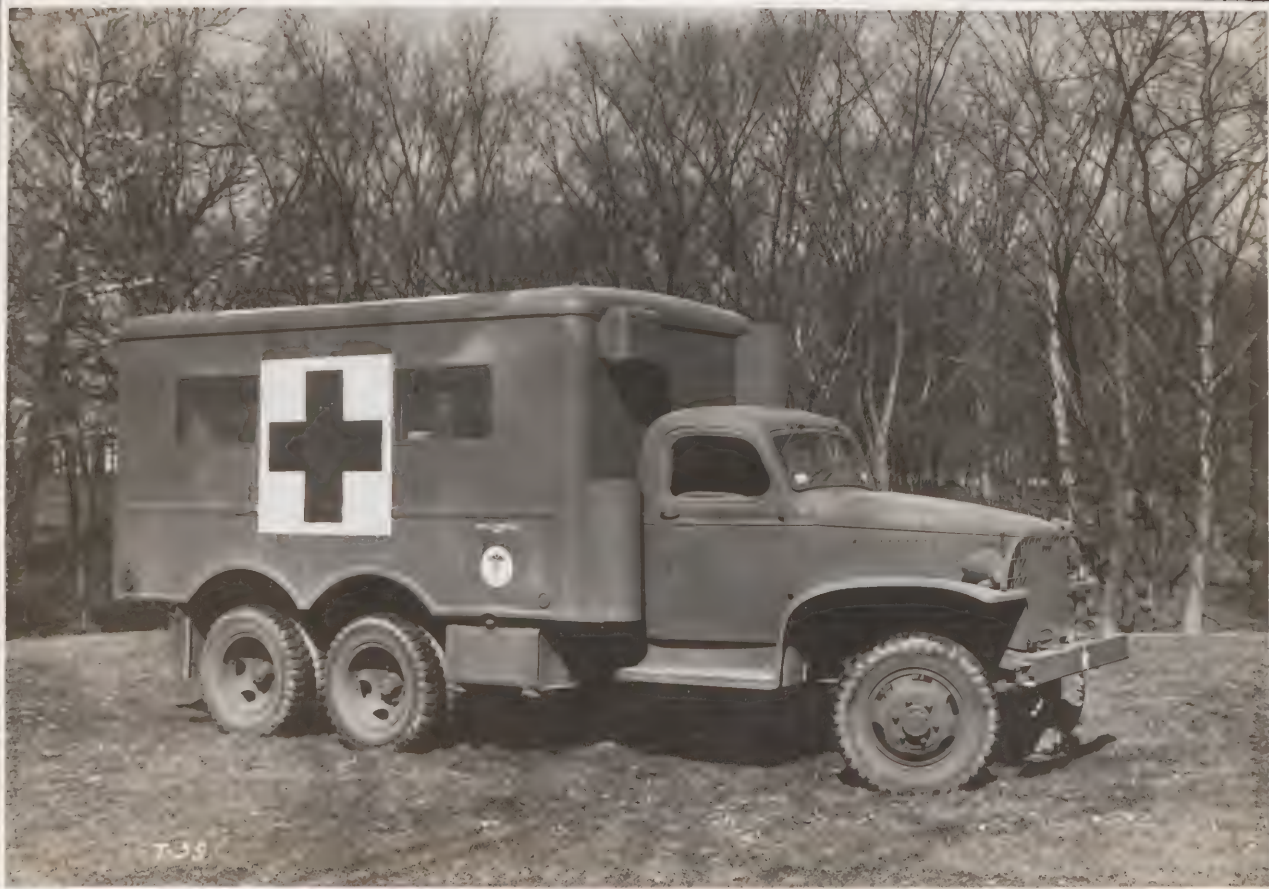


*Fig. 30*  
Illustration 2. Interior View of Truck, 2½-Ton  
6x6, Optical Repair Unit.

Source: Medical Department Equipment Laboratory  
Photo S-368.  
(Chapter IV, Truck, 2½-Ton, 6x6, Optical  
Repair Unit.)

*Fig. 30*









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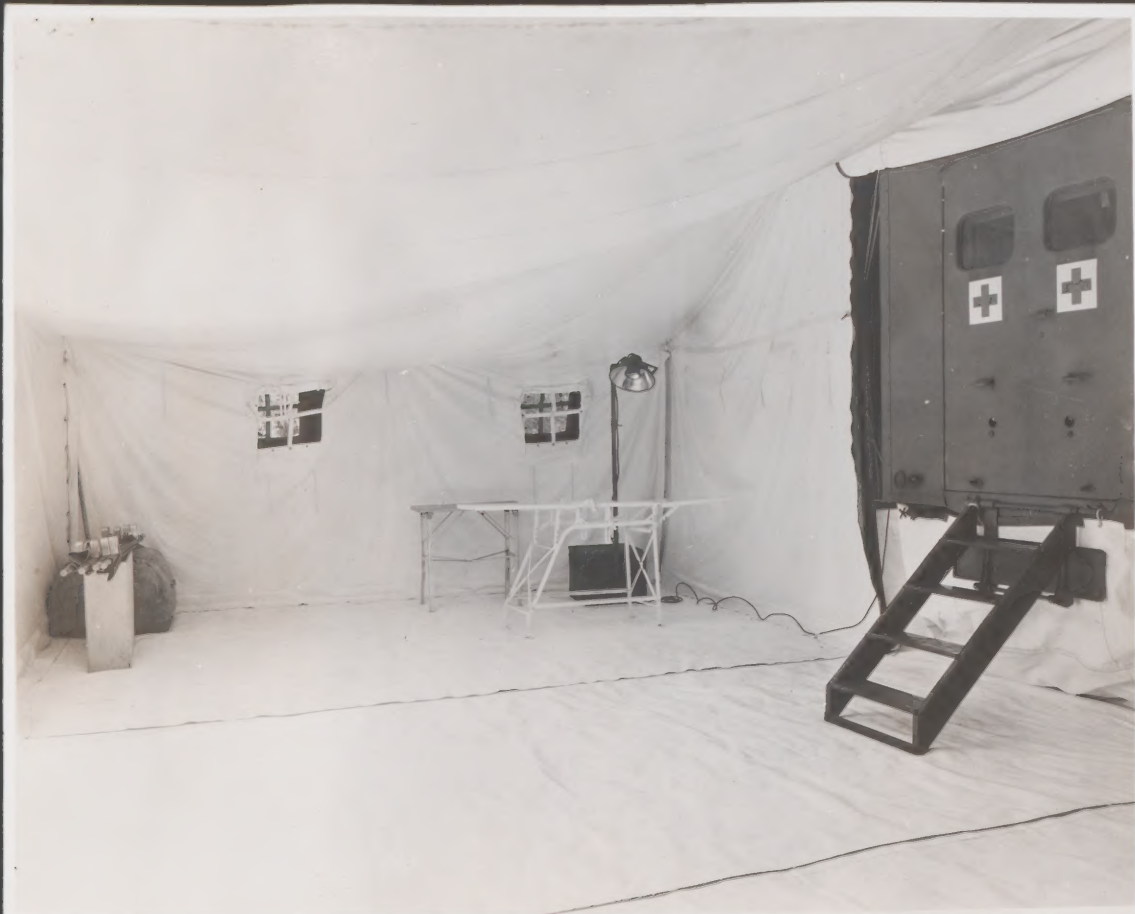




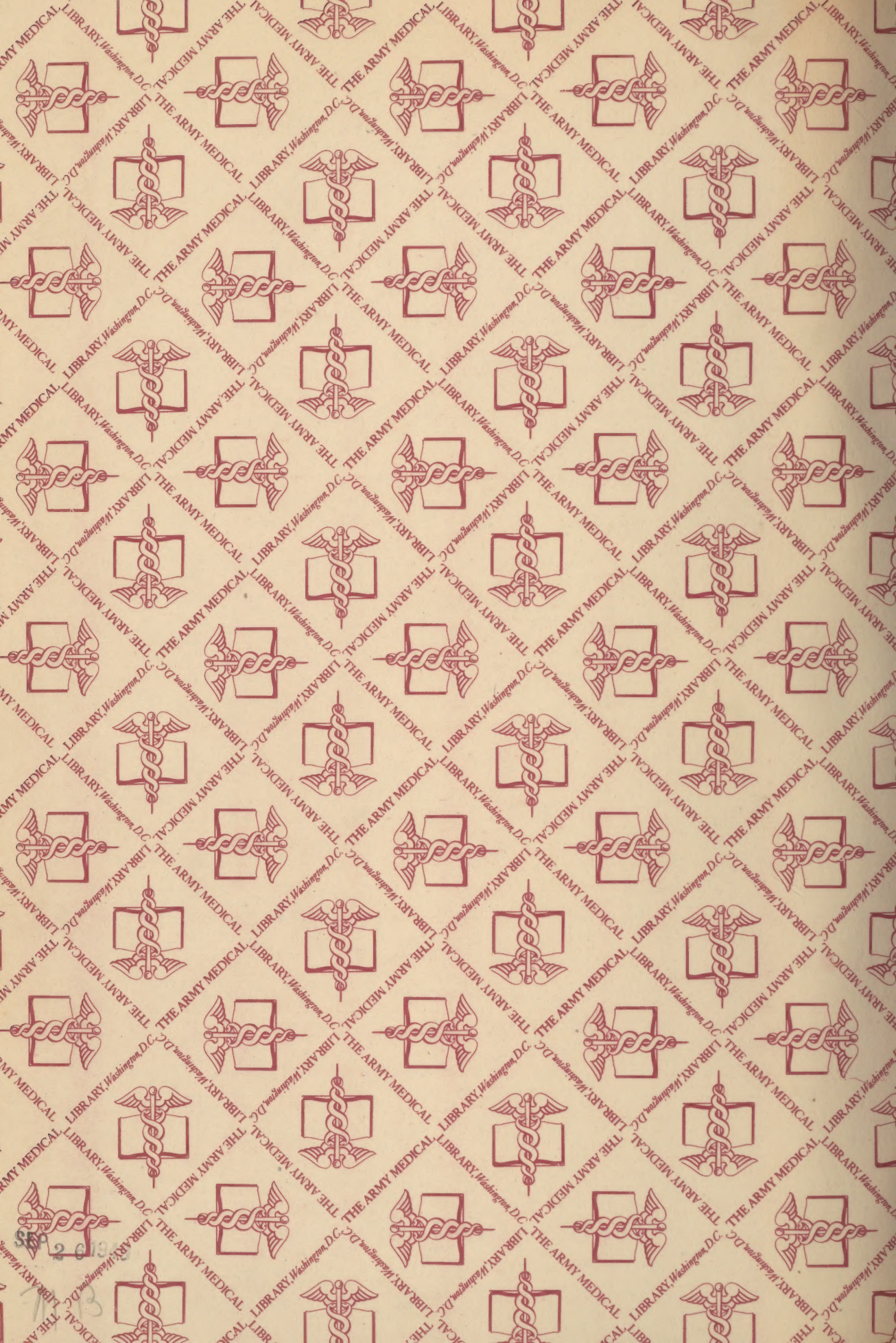


















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